DOCUMENT RESUME

ED 086 178 IR 000 024

AUTHOR	Schur, Herbert
TITLE	Education and Training of Information Specialists For the 1970's.
INSTITUTION	Organisation for Economic Cooperation and Development, Paris (France).
PUB DATE	73
NOTE	87p.
AVAILABLE FROM	OECD, 2, rue Andre-Pascal, 75775 Paris CEDEX 16, France ($2.00)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Educational Programs; Graduate Study; Higher Education; *Information Science; *Information Scientists; *Program Descriptions; Publications; Surveys
IDENTIFIERS	Europe; United States

ABSTRACT

Economic pressures, technological changes and political decisions will affect the structure of information systems. There will be a need for the provision of more accessible, more comprehensive, faster and more standardized statistical information systems coordinated on interdisciplinary and international bases. A staff will be required to develop, design and operate the information system. A broad, basic education in information science will be needed in addition to specialization. Education programs can be examined according to three variables: work orientation, professional level and specialization. Program organization and topics taught should be correlated to these variables. In actual practice, most of the schools examined in the United States included the topics of information storage and retrieval, indexing, and content analysis and design. Few taught mathematical tools, the scientific bases of a subject or research methods. The European programs vary considerably although many include organization and dissemination of data and more mathematics and linguistics than in the United States. The majority of existing programs are limited by a narrow view of the field of information science. (JG)

EDUCATION AND TRAINING OF INFORMATION SPECIALISTS FOR THE 1970's

by
Herbert Schur

University
of
Sheffield

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

EDUCATION AND TRAINING OF INFORMATION SPECIALISTS FOR THE 1970's

by
Herbert Schur

University
of
Sheffield

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The Organisation for Economic Co-operation and Development (OECD) was set up under a Convention signed in Paris on 14th December, 1960, which provides that the OECD shall promote policies designed :

- *to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;*
- *to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;*
- *to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.*

The Members of OECD are Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

* * *

The opinions expressed and arguments employed in this publication are the responsibility of the author and do not necessarily represent those of the OECD.

PREFACE

This study forms part of the O.E.C.D. policy research programme in the field of information and as such is intended to contribute to the formulation of government policy in O.E.C.D. Member countries. It has also been undertaken in the context of the new trends in the O.E.C.D. science and information programmes. These programmes are increasingly concerned with the relationships between science, economic growth and social progress and with policies which seek to ensure that science, including the social sciences, makes an effective contribution to the fulfilment of the economic and social goals.

The conclusions of the report have been noted by the Committee for Scientific and Technological Policy which recommended its publication.

CONTENTS

Chapter 1

INTRODUCTION

The report of this study is based on a personal interpretation of several hundred papers, reports, programmes of studies, course outlines and other material, on that of discussions with one hundred, or so, professors and practitioners in France, the Federal Republic of Germany, the Netherlands, Sweden, the United Kingdom and the United States, with officials in the O.E.C.D. and other organisations, and with colleagues in the Postgraduate School of Librarianship and Information Science in the University of Sheffield.

In sifting this wealth of material much has had to be left out if the reader was not to be submerged by detail and by discussions of the very many specific problems and "special cases" arising in programme design; also many of the details of the individual programmes studied have had to be omitted unless they were considered to be of general interest and value. Thus this report is not intended as either a scholarly dissertation, or a comprehensive state-of-the-art study, but one containing sufficient background, detail, comment and specific recommendations to serve its purpose as a policy planning document.

Terminology

In this report we attempted to be consistent in the use of terms, but, as often is the case, absolute consistency is not likely to have been achieved. However, we do hope that the meaning of the terms used will, in all cases, be clear from the context.

We use the expression "information specialist" in preference to the narrower, and often misunderstood, expressions of "information scientist", "documentaliste" or "Dokumentar", or the new term "informatik", as used by the Institute of Information Scientists in the United Kingdom, the American Society for Information Science in the United States, the Association Française des Documentalistes et des Bibliothécaires Spécialisés in France, the Verein Deutscher Dokumentare in Germany, and VINITI in the U.S.S.R., respectively. In our view, the expression "information specialist" includes all these and others and is, moreover, independent of the category of work which may range from system operation to background research. The field of the information specialist may be described operationally as that represented by, and in, such publications as the Annual Review of Information Science and Technology, the Referativnyi zhurnal: informatika, and the Library and Information Science Abstracts, together with areas in some neighbouring fields such as in human communication, psychology, and linguistics. In our view, large areas of modern librarianship and areas in data processing are included in the field of the information specialist.

By "information science" we understand the scientific foundations of the field of work and study of the information specialist, and if some areas of this science are also claimed by others, then the position is no different from that in, say, chemistry, where substantial parts can also be claimed by the physicists; and if the existence of an information science is denied, then the position is no different from that taken by some in relation to medical or engineering science.

In view of the different interpretations given to the term "information" we attempted, not very successfully, to avoid its use, as far as possible, and in its place usually used the term "data" as in "data base" so as to retain the generality required for encompassing all the different types, representations and sources.

Finally, we use the term "programme" for the scheme (plan) of studies comprising the selected topics to achieve the particular objective in mind; the term "course" for a prescribed series of lectures and other studies of a limited number of topics (and usually taught by one teacher over a short period of time); and the term "topic" as a discrete subject of discourse. The term "curriculum", used by OECD, was taken to be a synonym of "programme".

Chapter 2

INFORMATION SPECIALISTS FOR THE 1970's

In attempting to visualise the kinds of information specialists required in the next ten years or so, we first have to have some picture of the changes likely to occur in the demands made on the information systems and of the consequential changes in the functions and structure of the systems. We further have to take into account the probable consequences of technological changes on these and on the techniques likely to be used.

Demands

It is not expected that dramatic and sudden changes will occur in the demands made on information systems in the next ten years. Rather, it is assumed that changes will continue, as in the past, by the cumulation of apparently small changes, which, however, will occur at an increased rate and, because of the structure of the information systems network, are likely to be of more than local interest.

The pressures resulting from a growing awareness of the need for a broad systems approach to planning at all levels, together with the increasing realisation that consideration of techno-economic processes alone is not a sufficient basis for planning, leaving out, as it does, the social component - all these will result in strengthening the demand for change in the information systems serving planners. The principal pressures will be for the provision of more accessible, faster, more comprehensive, and more standardized statistical information systems co-ordinated on interdisciplinary and international bases. The systems will be required to operate S.D.I. (selective dissemination of information) services, carry out retrospective searches, and, if necessary, process the data stored (e.g. carry out statistical tests, compute correlations, and carry out various other analyses). The need for complex techno-economic-social analyses will further require a linking of some of the existing systems in science, technology, and the social sciences, with the statistical systems.

Specialised data banks will increasingly be introduced in a wide range of institutions and in support of a wide variety of aims, ranging from research and development to production and marketing and other "service" functions.

Examples of such systems include those already operational in various institutions serving in support of pharmaceutical research, preventive medicine, ionospheric and weather forecasting, banking, insurance, crime prevention and detection, and mail order store control, to mention just a few of a wide variety. Such systems will increasingly be used not only to provide information, but directly to use the information to control the performance of various operations in laboratories, offices, factories, and transport, particularly in areas of employment where the man/machine cost ratio is high and increasing, and the reliability ratio is low and decreasing.

A notable factor in the social and economic development in most, if not all, countries in the world is that of the continuing rapid growth in education, both quantitatively and qualitatively. In every age group, between the ages of three and the mid-thirties, or higher, an increasing proportion is engaged in full- or part-time study. In almost every country the duration of compulsory school education has increased and is continuing to increase, as is the length of voluntary post-school education. The major consequences of this continual increase both in the numbers and the level of educational attainment are the increased pressures on existing libraries, particularly the public libraries, and on the library and information facilities, if any, in the educational establishments. A secondary consequence is the growing quantitative and qualitative demand for information services in connection with the individuals' further employment. In the education sector one may expect that developments will occur at the interface between various information systems and programmed learning systems, particularly if linked by the use of associative and other programmes.

The failure of all attempts, so far, to achieve agreement on the use of a single language for scientific communication (not to mention communication in other areas) on a world-wide scale is of considerable importance for the development of information systems. Although, de jure, the United Nations Organisation accords equal status to Chinese, English, French, Russian, and Spanish as the official languages, other languages are of major practical international importance, so that the de facto list of important languages is not confined to these five. The "language barrier" is already considerable and will grow even more in importance and complexity, and we may therefore confidently expect a further rise in the demand for translations. We do not expect that this demand will be met by means of machine translation, except in the highly specialised cases of translating between strictly formalised languages. We expect that the demand will increase most rapidly not in the "pure" science but in applied science and technology. We also expect a steep rise in the demand for translating in the social sciences and in connection with the techno-economic-social planning mentioned earlier. The demands, which at present are largely concentrated on translating from and to a few major European languages, including English, French, German and Russian, will, within the period considered, extend increasingly to Japanese. We also expect Chinese, Spanish and Portuguese to increase in importance with the growing technological development of China and the Latin American countries.

Functions

The functions of information systems will increase in their variety at all levels from local to world-wide systems, and also in their comprehensiveness. There will be a shift in the primary functions of existing systems resulting from the fuller co-operation and co-ordination of effort of the various systems. At all levels these changes will require more effort to be devoted to the development and maintenance of the "matching" sections in the systems, that is the sections at the system/system and man/system interfaces.

The shift in the primary functions will be particularly pronounced at the system/user interface where much greater efforts than hitherto will have to be made to enable and help the user to exploit the information system more fully. Ease of access and ease of use will be the primary demands of the user.

The functional changes in academic, large public and, to a lesser extent, industrial libraries, will lead to a reduction in the differences existing among these, particularly as all will, to a greater or lesser extent, be providing active information services and become relatively less concerned with the building-up of comprehensive collections of literature and with their archival functions.

Structure

The structure of information systems and system networks will change as a result of strong economic pressures, technological changes, and political decisions.

Economic factors

The major component in the current costs of a typical information system has, in general, been that related to manpower, followed by the components related to materials, equipment, and, finally, communications. We expect that, in relation to a general costs index, such as a cost of living index, manpower and materials cost indices will continue to rise whereas equipment and communications costs indices will continue to fall. The consequences expected to flow from this will include increased pressure for a "rationalisation" of information systems and system networks particularly in relation to the use of manpower and in the acquisition and storage of material.

Rationalisation of information systems and system networks will aim at maximising the "benefits" from the services provided whilst minimising the costs of providing them. It is not yet clear how the benefits will be determined, but there is evidence that to an increasing extent, in some countries at least, benefits will be assessed largely in terms of income from the sale of services by the system, and that policy will tend to encourage information systems to become financially self-supporting. While there exist some excellent commercially run information systems, such as those of the Institute for Scientific Information in the United States, or of Derwent Publications Ltd. in the United Kingdom - and it is clear that these organisations have found the right products for a market willing and able to pay the economic price - it is not obvious that the commercial criterion is applicable in all cases. In particular it is doubtful whether the "benefits" should invariably be assessed in terms of system income only. Nevertheless we believe that increasing financial pressures will inspire a more commercial attitude to, and in, information systems and networks, and as a consequence the need for increasing income from the sale of services will lead to concentrating resources on the provision of economically viable services and to pruning severely those which are not paying in terms of money, national need (e.g. defence), or prestige.

The increased cost-consciousness will lead to detailed cost-effectiveness studies and a re-assessment of operations and services provided by information systems in terms of needs and alternatives. As in industry, the acquisition of part-processed or even fully processed "raw material" will become economically more attractive, particularly in view of the new possibilities for further processing which will result from technological changes.

The continually increasing volume and unit cost of material will lead to the need for use-related acquisitions and storage policies. We may therefore expect a further development of a hierarchy of back-up schemes, where local networks would provide "same day" service for urgently required material, national lending libraries a "next day" service for the largest part of the remainder, and co-operating services (on a national and international scale) a "same week" service for rarely used material. The major problems to be faced will be those of organisation, the technical problem of transmission of the materials, and the legal problem of copyright. The fact that material will come in an increasing variety of physical forms will not, in itself, pose fundamentally new problems.

Until recently expenditure on technical equipment accounted for only a small fraction of the budget of most information systems. Within the next few years this will change radically and equipment for the production, use and processing of machine-readable records, for reprographic needs, and for telecommunications purposes will account for an increasingly large part of systems budgets. While growing and expanding systems will be able both to mechanise and to maintain or even increase staff numbers, systems which have reached a budgetary plateau may find themselves in a difficult position which, if unsolved, will lead to a rapidly widening productivity gap (for operations and services which can economically be mechanised) between the two groups. Thus, again, pressures resulting from the "equipment" component of costs will lead to a re-assessment of functions and structures of systems.

As stated earlier, we expect the communications cost index to fall in relation to the general costs index, particularly because of the continual fall in telecommunications charges. At the same time, as telecommunications facilities and services are improving and expanding, postal services are deteriorating, both in regard to cost and to speed of transmission. The consequences of these trends will be complex, but it is clear that a fairly expensive shift towards a greater use of telecommunications facilities will take place, particularly for operations where the operation cycle time is short and the time for transmission would therefore account for a substantial part of it.

Technological factors

We expect that the development of large capacity,cheap direct access machine readable stores will promote the rapid growth of computerised data banks and data-based information systems. This development will mean that, to an increasing extent, records will be kept in machine readable form only and will be read indirectly rather than from written or printed record.

On the other hand, we expect that in the great majority of literature-based information systems, information will continue to be stored and made available in printed form,particularly because of the relatively low cost of printed material and its user convenience. This material will, as already mentioned, be supplemented more and more by material in other physical forms (e.g. microform, magnetic tape). Except, however, in a few special cases, the proportion of material in non-printed form will remain small. In this type of information system programmed machine processing will increasingly be used for "housekeeping" operations, that is the "clerical" operations involved in all the stages from ordering material to lending, using equipment ranging from tape-typewriters through small low cost computers to large shared computers. We expect such equipment also to be increasingly used in the preparation of copy for publishing, particularly where repeated selective alterations are likely to be required, as in lists, tables, handbooks and other frequently revised material.

In the area of computerised information retrieval the existing and expected technical possibilities exceed by a large margin the economically justifiable ones. At present the output of the large computerised information systems providing bibliographic, indexing, abstracting and other services is usually made available in printed form at a price about one order of magnitude lower than the output in machine readable form. Few organisations require all the information made available by even one of these systems - and there are some ninety or more operational now - yet no one system will supply all the information required by even a relatively small user. We therefore expect the development of S.D.I. services to a variety of user organisations, user groups and individuals, where some of these organisations will, after combining the inputs from several such services, themselves produce S.D.I. outputs for their users. The question remains as to who uses directly the machine readable records produced by the large information systems, and on present evidence it appears that these will require to be searched first of all by the originating systems themselves, secondly by new specialised mechanised information services, and thirdly by large (in terms of financial resources) and specialised (in subject coverage) information units. We do not anticipate a fast growth or a large demand for information in machine readable form from these large services unless a considerable price reduction takes place, and until a larger number of user information systems has moved in the programmed machine processing of internally produced information to the use of computers.

In addition to the provision of S.D.I. services, two other services are of interest, namely the provision of one-off searches of recent material and that of material covering a long period of time. Again, technically, there are no difficulties in carrying out both of these, but the economic problem of searching a large, and possible not well structured, data base covering a long period of time is such that only searches of recent material are likely to be requested on an increasing scale. Until technical problems, such as the availability of a large capacity, cheap, direct access, machine readable store, and the more difficult problem of "software" for searching language-based files, are solved, we expect progress in machine searching of long runs of such files to advance more slowly than the two other services discussed. We should point out, however, that we do not expect this to apply to the searching of data bases with well structured material such as that of chemical compounds, where full retrospective searches should be technically and economically feasible.

The major technical changes expected in telecommunications are the extension of direct dialling on a world-wide scale for telephone, telex, and, to a more limited extent, for high-speed data transmission, and the growth of telecommunication via satellites for broad-band needs (e.g. colour television, high-volume high-speed communication). These changes will be of major importance in only a small sector of information system networks, such as in international trade, banking, finance, and news media operations where the "half-life" of information may be measured in minutes and hours rather than months and years as in scientific research. Improved telecommunications will allow for interconnection of computerised systems and for increased use of remote terminals connected directly or via satellite computers, and the improvement and extension of telex will lead to a speed-up of interlibrary loans (on a national and international scale) and of inquiry work in particular cases. The progress in the more intensive use of modern communications facilities will be particularly pronounced in information systems serving international companies where these facilities are also being heavily used by other divisions of the company. We do not expect improved telecommunications to have any significant effect on the "affluent scientific commuter" who, as before, will find his travels to other laboratories, institutions, or manufacturing plants essential for most effective and efficient information transfer.

Political factors

These are largely outside the scope of this study. Nevertheless it needs to be pointed out that political decisions will strongly influence the functions and structure of information systems and system networks, and to the extent that decisions can take a broad non-national view, it will be possible to maximise on an international scale the benefits flowing from the application of efficient management methods and of the findings of information science and technology

In the next ten years or so, we expect growing co-operation and collaboration between OECD countries, an increasing share of the contribution coming from Europe and Japan. In particular, we expect that the free movement of information workers, which will be promoted by the abolition of regulations inhibiting the free movement of labour between countries, and various social measures, will have a significant impact on the rate of diffusion of modern methods and techniques and will also increase the effectiveness of international collaboration.

Information specialists

Given the changes likely to occur in the demands made on information systems, the changes in the functions and structure, and the changes resulting from technological developments, what kinds, then, of information specialists are likely to be required in the next ten years or so?

In broad terms, we shall require staff to develop, design and operate information systems, which, as we already noted, will together serve an increasing variety of needs and which, individually and jointly, will aim at providing faster, more comprehensive, easier to obtain, and easier to use services for the user. The increased co-operation and co-ordination among systems locally, nationally, and internationally, will require staff with a broad basic education in information science and technology, and the need for increasing the rate of progress in the implementation of change will require such staff to be flexible and adaptable. Here again, a broad basic education will be valuable and indeed necessary, but in addition we do, of course, envisage the need for specialisations developed from the basic education.

For the successful development, design, and operation of information systems even the combined basic education and specialisation are not yet sufficient and we would therefore add to the scientific and technical expertise high grade management expertise and ability. Above all, we shall require more men and women of real ability, considerable imagination and sound judgement to enter the field so as to advance the theory and practice of information work in all countries.

We envisage that the career-orientated, professional information specialist staff will be supported by specialists from other fields, particularly for work at the system interfaces with the generator and user of information, at system/system interfaces, and for work involving the use of various technical equipment.

Chapter 3

EDUCATION AND TRAINING PROGRAMMES FOR THE 1970's

In planning the provision of the set of education and training programmes required to satisfy national and international needs, we shall first identify the major types of individual programmes and second consider their subject content and structure.

For practical reasons, the number of factors which should be taken into account in identifying the major types of programmes has to be kept very low. We believe that it is possible to design a useful and practicable set of programmes on the basis of three factors only, namely:

(i) category of work,
(ii) level of work, and
(iii) major branch or specialisation.

Category of Work

The range of activities in information work extends from operation of information systems networks and units to background research in information science. Four main categories may be identified as follows:

(i) operation (C1),
(ii) design and development (C2),
(iii) applied research (C3), and
(iv) background research (C4).

Operation (C1): For our purpose this means the day-to-day operation of, and in, new and existing information units, systems, and system networks.

Design and Development (C2): This type of activity is concerned with adapting the store of existing and new knowledge to particular circumstances. It includes the systems analysis and design of an information unit, system, or system network at one extreme, and that of a part of a unit at the other. We expect the information specialist to collaborate in the development and design of "hardware" and "software" required for information work with other specialists, e.g. engineers, computer specialists, etc., when appropriate.

Applied research (C3): This type of activity often arises out of a recognition of the need for more data or for a deeper understanding of factors and problems encountered in design and development work. In other cases, it is work which bridges the gap between research findings and the designer by translating these findings into a form usable by the designer.

Background research (C4): This is research which, whilst still very far from the application stage, is nevertheless recognised as adding to the store of knowledge of potential use at the applied stage. Studies of the information transfer processes and communication in general, of learning, short and long-term memory, of logic processes, of linguistics, of theories of automata, or of physical or other phenomena ultimately leading to the development of new "hardware" for information transformation and transmission, may all be taken as examples of background research topics in which work is being actively pursued in various research centres all over the world.

Level of work

The second factor to be taken into account is the level of work expected of a programme graduate on qualifying (this, in the case of professional qualifications in some countries, may require several years of professional experience after graduating). Although there is bound to be some overlap between the upper end of one level and the lower end of the next higher one, we believe that the following four levels should be adequate for broad planning purposes, namely:

(i) assistant (technical) (L1),

(ii) first professional (L2),

(iii) second professional (L3), and

(iv) advanced professional (L4),

or the equivalent academic levels. The meaning of these levels may become clearer when we consider the individual programmes.

Branch or specialisation

In considering the broad structure of a set of programmes, we may usefully divide the set into three elements, namely:

(i) programmes for information specialists to be concerned with substantially natural-language based systems (B1),

(ii) programmes for information specialists to be concerned with symbol, graph, or similar basis systems (B2), and

(iii) "matching section" programmes for specialists in other fields for specialised information system work (B3).

Set of programmes

In Figure 1 we have summarised the three factors requiring to be taken into account in identifying the major types of programmes in the set. Whilst it is theoretically possible to cover several categories of work in a single programme and at a given level, to do so would, we believe, be totally unrealistic. The most that should be attempted in programmes for branches B1 and B2 should be to cover two adjacent categories, one as the primary objective, the other as a secondary one. The resulting set of nine programmes in either branch is shown in Figure 2.

Figure 1

EDUCATIONAL PROGRAMME DESIGN FACTORS

Branch of work	natural language base systems B1	symbol-, graph-base systems B2	specialists B3	
Category	operation C1	development design C2	applied research C3	background research C4
Level	assistant (technical) L1	first professional L2	second professional L3	advanced professional L4

Figure 2

SET OF PROGRAMMES FOR BRANCHES B1 AND B2

Category / Level	operation C1	development design C2	applied research C3	background research C4	programme
assistant (technical) L1	x	-	-	-	P1
first professional L2	x	o	-	-	P2
second professional L3	x o -	o x x	- - o	- - -	P3 P4 P5
advanced professional L4	- - - -	x o - -	o x x o	- - o x	P6 P7 P8 P9
		x = primary objective o = secondary objective			

This set of programmes provides no fewer than seventeen main specialisations in branches B1 and B2 taken together, of which one is common to both branches [the programme at the assistant (technical) level] two are at the first professional level, six at the second professional, and eight at the advanced level. In addition there is a set of "matching section" programmes, including those required for training subject analysts and liaison officers.

The objectives of the main programmes are as follows (see also Figure 2 and Figure 3):

P1: a single programme for the assistant (technical) to provide supporting staff capable of working with only a minimum of supervision in the essentially clerical and technical positions in an information unit such as any type of library, information analysis centre, or computerised data bank

P2: two parallel programmes for the first professional level to provide professional staff for natural-language based systems, such as libraries, documentation centres or some information analysis centres, and, alternatively, for symbol- or graph-based systems, such as numerous data banks and data analysis centres in support of engineering, medical, management and scientific research, development and operation needs. We envisage that the great majority of programme graduates will be required for operational work which we expect to absorb initially some 75 to 80 per cent (or more in some countries) of all professional staff, but we also envisage that most of them will, during their career, be involved in the development and design particularly of smaller and non-experimental units and systems. The programme is therefore designed so that the primary objective is "operation" and the secondary one "development and design".

P3: two parallel programmes at the second professional level, one in each of branches B1 and B2, for those wishing to specialise further in operational work. With the heavy accent on management and related topics it is expected that the graduates will be those normally capable of rising fairly rapidly to the most senior positions in large and/or sophisticated units, systems and system networks via the management and operations route.

P4: two parallel programmes at the second professional level, one in each of branches B1 and B2, for those wishing to specialise further in design and development, whilst at the same time attaining a high level of operational expertise. It is envisaged that graduates will be those normally capable of rising to the most senior positions, particularly in the more rapidly changing units and systems where continual development and design is required, or that of acting as consultants for systems analysis and design, a possible exception being the design of highly sophisticated experimental systems or those requiring specialised deep knowledge of the data base.

P5: two parallel programmes at the second professional level, one in each of the branches B1 and B2, for the research orientated designer. The programme is similar to, but less specialised and deep than, programme P6. Because of its greater breadth compared with P6, the graduate is likely to have a useful background for tackling a wide variety of designs, even though it is insufficient for the few cases requiring specialised deep knowledge in some branch of applied research, such as applied research in connection with a particular data base.

P6 to P9: these programmes are envisaged as leading to a Ph.D. or equivalent professional degree, such as DLS or Dr.Ing. The principal accent is on research, which in most countries entails individual work under the personal guidance of the study supervisor, rather than on the completion of a number of taught courses. Whilst we envisage each student having an individually designed study programme, we can here distinguish between four main programmes, according to their objectives.

P6: research primarily directed to problems of design and development of information units, systems, and system networks, with particular attention to applied research findings.

P7: applied research in information science and technology with reference to design and development applications.

P8: applied research in information science and technology with particular reference to findings in background research; and finally

P9: background research with some attempt at relating the findings to possible applied research investigations.

Pure research is outside the scope of this study, but the view should be recorded here that, as in science, pure research is not only relatively cheap, but the benefits derived from even a few successful findings can be very large indeed. Pure research, even though its benefits may be obtained only in the long-term rather than the medium or short-term, should be supported, and promising individuals should be encouraged to follow up their ideas.

Content of programmes

Information systems, as has been pointed out in Chapter 2, take a wide variety of forms and are designed to satisfy a wide variety of requirements. We have also distinguished between the two main branches of information systems, that is those using principally a natural language data base and those using a symbol-, graph-, or similar data base. We have further stated that we envisage increased co-ordination and linking of the various systems, and that therefore the programme requirements are (i) breadth, (ii) some specialisation, and (iii) common ground among information specialists, and between them and the co-operating specialists from outside the field, particularly at the first two professional levels.

These requirements, which are designed to ensure career flexibility and ease of co-operation among the various specialists, can easily lead to overloaded programmes, and we therefore prefer to include the more theoretical topics in the programme at the expense of some practical training which, we believe, can in most of the advanced countries be obtained by training in employment, possibly by means of special "graduate trainee" schemes. We shall revert to the problem of practical training in Chapter 5. The priority given to theoretical topics in the programmes at the professional levels does not mean to imply a value judgement whereby "theory" would be more highly rated than "practice", but it reflects, as stated, a division in education and training between those parts which can best be done by an educational institution, and those which can be acquired through professional practice. We should, however, stress that in developing countries ("developing" in respect of information systems) such a division of responsibilities may not be feasible, and in these countries differently structured education and training programmes would be required to ensure not only competence in theory, but also in the practice of the profession.

We have identified six main clusters of topics and in Figures 2 and 3 we have indicated the relative importance we believe should be attached to the individual topics in the various programmes. By "importance" we wish to indicate the

Figure 3

TOPICS IN PROGRAMMES P2-P5

Topic	P2 B1	P2 B2	P3 B1	P3 B2	P4 B1	P4 B2	P5 B1	P5 B2
1. Generation and use of data bases								
(1) Generation and use of data bases	2	.	2	2	2	2	.	.
(2) Human communication	.	.	.	.	3	.	2	.
2. Data bases and their characteristics								
(1) Data base sources and resources	1	.	2	.	3	.	.	.
(2) Macro- and micro-characteristics of data bases	3	2	2	2	1	1	1	1
(3) Natural and formal languages	.	.	.	.	.	.	2	2
3. Organisation and dissemination of data								
Survey	1	1	1	1	1	1	1	1
(1) Data acquisition, description, compression	2	.	2	.	2	.	.	.
(2) Taxonomies, classification of data	2	.	2	.	2	.	.	.
(3) Indexes and indexing	2	2	2	2	2	2	.	.
(4) File structure and organisation for retrieval	2	2	2	2	2	2	.	.
(5) Data transmission, communication, dissemination	2	2	2	2	2	2	.	.
4. Information storage and retrieval (ISR) systems								
(1) ISR systems analysis and design	1	1	1	1	1	1	1	1
(2) System/system and system/man interfaces	.	2	3	2	2	1	.	.
(3) ISR systems and systems networks	2	2	2	2	2	2	.	.
(4) ISR systems environments	2	3	1	1	2	2	.	.
(5) ISR systems operation	1	1	1	1	2	2	.	.

(for notes, see next page)

Figure 3 (Continued)

TOPICS IN PROGRAMMES P2-P5

Topic	Programme and Branch							
	P2		P3		P4		P5	
	B1	B2	B1	B2	B1	B2	B1	B2
5. Theoretical and technical tools								
(1) Mathematical foundations	.	2	.	2	3	2	2	1
(2) Research methods	.	.	.	.		.	2	2
(3) Operational research	.	.	3	3	3	3	2	2
(4) Statistical methods of research	3	.	2	3	1	3	1	2
(5) Management principles and techniques (incl. financial management)	2	2	1	1	2	2	.	.
(6) Technical equipment for ISR systems: characteristics and use (incl. computers)	2	2	2	2	1	1	1	1
6. Special topics								
(1) Advanced computer programming (and organisation) natural language	3	.	3	.	2	.	2	.
numerical, graph	.	2	.	2	.	2	.	2

Notes:

1 = required (core)
2 = recommended
3 = optional

B1 = natural language base systems
B2 = symbol-, graph-base systems

First professional level programmes: P2
Second professional level programmes: P3, P4, P5

Machine (computer) problems, methods, and techniques are considered together with "manual" ones within each topic, as appropriate

For description of these programmes and programmes P1, and P6 to P9, see text.

priority for inclusion in the programme rather than the amount of time to be given to the particular topic. The individual topics are not necessarily best taught in separate courses and we do envisage courses in which two or more topics would be presented in an integrated form, the decision on this depending on factors such as the capabilities of available teachers, students, and available physical resources.

The six main clusters of topics may be included under the following headings:

(i) Generation and use of data bases,

(ii) Data bases and their characteristics,

(iii) Organisation and dissemination of data,

(iv) Information storage and retrieval (ISR) systems,

(v) Theoretical and technical tools, and

(vi) Special topics.

The brief scope notes on the various topics given below should not be taken as syllabus outlines, but only as indicative outlines of the scope of topics. Nor do these notes show the depth of treatment of the topics; generally speaking, one would expect greater depth of treatment in core topics and at the more advanced levels than in essentially introductory courses.

Topics: scope notes

1.1 Generation and use of data bases: macro- and micro-characteristics of data production (e.g. science of science) and use; information needs and information seeking behaviour, and the effect of historical, social, psychological, economic, technical and other factors on this behaviour See also 4.4.

1.2 Human communication: the senses; the brain, cognition, recognition, memory, learning; signs, language, signals, codes; oral, written, and other means of human communication. See also 2.3.

2.1 Data base sources and resources: General and special sources; internal to organisation, external; published, unpublished; documents and other media, instruments, machines, and men as sources.

2.2 Macro- and micro-characteristics of data bases: structure volume, frequency distributions of occurrence and use; characteristics of data representations; transformation properties; measures. See also 2 3.

2.3 Natural and formal languages: linguistic classifications; modalities in language; semantics, pragmatics, syntax; the relation of semantics and linguistics, psychology, logic, and philosophy; the development of language; theory of signs; logic, propositional calculus; artificial languages; communications theory; language analysis, redundancy, homogeneity; computer languages. See also 5.6.

3.1 Data acquisition, description, and compression: methods, processes, products; "manual" and "automatised" methods and processes; production of abstracts, indexes, catalogues.

3.2 Taxonomies; classification of information: taxonomies in science and other fields; theories of classification; "manual" and "automatised" methods and processes for particular applications and types of data base. See also 3.3.

3.3 Indexes and indexing: methods, processes, products; indexing of natural language, formal language, symbol, graph and other data base material; "automatised" indexing; production of indexes in different formats and physical form. See also 3.2.

3.4 File structure and organisation for retrieval: types of structure; file maintenance; "manual" and "automatised" methods of retrieval; retrieval strategies; efficiency, effectiveness.

3.5 Data transmission, communication, dissemination: message, code, channel, source, designation, destination; communication theory; technical means of transmission and dissemination; methods, processes, products. See also 3.1 and 1.2.

4.1 ISR systems analysis and design: methods and procedures; determination of objectives, constraints, criteria; ISR sub-systems, output, input, processing and storage, feedback, control; operational requirements; equipment, accommodation, staff, data base, methods; models; evaluation; effectiveness, efficiency. This is an "integrating" topic which draws to a greater or lesser extent on all the other topics outlined.

4.2 System/system and man/system interfaces: special study of system interface matching problems. See also 1.1, 2.1, 3.1, 3.5, 4.3 and 4.4.

4.3 ISR systems and systems networks: study of selected operational systems and networks.

4.4 <u>ISR systems environments</u>: study of the ISR system in the institutional, mission, discipline, local, national and international environments; the objectives, structure, organisation, and policy of selected institutions (e.g. universities, industrial concerns); the ISR system in society; moral and legal problems.

4.5 <u>ISR system operation</u>: methods and procedures; functions and structure of the system; operational problems of ISR sub-systems, output, input, processing and storage, feedback, control; problems of equipment, accommodation, staff, data base, methods; operational targets; staff, operation, and financial control; evaluation; effectiveness, efficiency. This is the operational counterpart to 4.1. See also 5.5.

5.1 <u>Mathematical foundations</u>: functions, sets, mapping; errors and accuracy; operations and morphisms, finite differences; inequalities; sequences and limits; logic, Boolean algebra, proof; integration, differentiation; differential equations; probability and statistics; relations; linear algebra; complex numbers; groups; graph theory; number theory; topology; mathematical structures. The required basic level corresponds approximately to that of the Mathematics Foundation Course of the Open University (England).

5 2 <u>Research methods</u>: historical development; deductive, inductive, hypothetico-deductive methods; specification of problem in general terms; study of subject background; outline research proposal; theoretical and experimental components; measures, sensitivity, accuracy; investigation; evaluation of results, errors, validity; conclusions; writing of report.

5.3 <u>Operational research</u>: historical introduction; OR problems; form of problem: inventory, allocation, queueing, sequencing, routing, replacement, competition, search; content of problems with particular reference to ISR systems; mathematical methods.

5.4 <u>Statistical methods of research</u>: formulation of problem; quantification, problems of definition; data collection methods; null hypothesis; choice of statistical test; level of significance and sample size; sampling distribution; region of rejection; statistical model; power-efficiency of tests; scales of measurement; nominal, ordinal, interval, ratio; non-parametric and parametric statistical tests; regression analyses; variance and co-variance; practical research design.

5.5 Management principles and techniques: forecasting, planning, implementing, controlling methods and techniques, strategic and tactical problems; organisational structure, management by objectives and by exception; management attitudes; barriers to change: historical, psychological, political, economic, technical, scientific, etc.; staff satisfaction and dissatisfaction factors; employment, underemployment, misemployment; incentives; staff recruitment, performance review, development and training, promotion; costing and budgeting; organisation and methods techniques, operational research, systems analysis and design.

5.6 Technical equipment for ISR systems: characteristics and use: equipment for production and use of machine-readable records; computers and computer peripherals; reproduction equipment, printing; microphotographic, ciné film, videotape equipment; sound recording and reproduction equipment; "teaching" machines; data transmission and reception equipment; basic computer programming.

6.1 Social topics: e.g. advanced computer programming, language studies, library building design, historical bibliography, etc., specialised advanced treatment of topics in 1.1 to 5.6 above.

Having outlined the objectives of the main programmes and the topics, we are now in a position to discuss the programme requirements in terms of topics, levels of their treatment, and of programme organisation.

Programme P1: Assistant (technical)

Traditionally, in many countries staff carrying out clerical and technical tasks in library and information units had been recruited directly among school-leavers and trained on the job. In some cases, because of the existence of part-time professional education, it was possible to recruit those studying for professional qualifications in librarianship or "information science" and to thus have well-educated and highly motivated staff in the assistant (technical) or equivalent (e.g. library assistant) posts. These methods of recruitment are no longer adequate, both for positive reasons, such as the increasing use and complexity of technical equipment employed, and negative ones, such as the effect of underemployment and misemployment of staff on costs and morale. It is therefore desirable to train suitable school-leavers for assistant (technical) work, to the benefit of employers and of the individuals concerned who acquire expertise and skills which are certain to be a valuable asset in a large number of similar posts in a wide variety of organisations.

There appear to be three main topics which would comprise the required part of the programme, namely:

(i) technical equipment for ISR systems: characteristics and use;

(ii) clerical procedures and routines; and

(iii) ISR systems procedures and routines.

The scope of these topics may be outlined as follows:

Technical equipment for ISR systems: characteristics and use: see notes on 5.6 above, with greater stress on use and routine maintenance, where appropriate, at the expense of details of characteristics of primary interest to a system designer. Additional material would include the use of desk and electronic calculating machines and of engineering drawing methods, drawing tools and equipment. A useful additional skill would be that of document repair.

Clerical procedures and routines: preparation, verification, and scrutiny of straightforward documents, statistics, records, accounts, and claims; the preparation of other documents, subject to checking; simple correspondence in accordance with well-defined instructions; simple drafting and précis work; collection of material on which judgements can be formed; operation and maintenance of correspondence files and filing systems; typing.

ISR systems procedures and routines: introduction to ISR systems objectives and operations; acquisition of material; checking and simple recording of material received; simple document storage and retrieval; sorting, merging, filing, selecting of coded records and documents; simple checking, proof-reading and preparation of material for reproduction; circulation and other routines; use of major reference tools and directories.

In addition to these required topics, students should be encouraged to select optional topics in accordance with their individual needs. These options might include the study of one or more foreign languages (to supplement and complement language studies at school), more advanced computer programming, probability and statistics, modern mathematics and other topics, to prepare the student for more specialised work or for entry to professional level programmes.

We assume that the normal entry to the P1 programme would be at the school-leaving age (e.g. in the United Kingdom at the age of 16 on completion of 11 years of compulsory school education) and that a satisfactory level of general education will be required (e.g. the Mittlere Reife in the Federal Republic of Germany, General Certificate of Education Ordinary Level or equivalent in the United Kingdom with at least five passes, including the national language, mathematics, and, in most countries, a major foreign language). We also assume that most (and, if possible all) students will be working in an information unit, data centre, library, or similar system.

This programme is probably best organised on a "sandwich" basis, and in a few areas on a day-release or evening study basis. A "sandwich" study programme involves alternate long periods of work and study, the ratio of which may vary from, say, three weeks and one week respectively for each stage, to a two-months study period once a year, or other ratios and periods The major advantage of a "sandwich" programme is not only the provision of a study period free from other work, but the increased catchment area of the study centre. In areas of high student concentration it is possible to arrange for a day-release basis, that is, a study period of one full day per week. Finally, with very high densities of students, that is, large numbers of potential students within a relatively short distance (in travelling time) of the centre, it is feasible to have evening courses and practical work, and thus also to provide for students whose employers are not able, or willing, to release the students during normal working hours.

Programmes P2: First professional

In most countries a substantial proportion of staff occupying professional level posts in information systems of the type considered here had no formal education and training in this field, partly because no suitable programmes were available and partly because graduation from the then existing programmes conferred no noticeable benefits in terms either of improved conditions of employment or of capability for carrying out the work required. In some sectors of employment, academic achievement alone was considered a necessary and sufficient condition for entry and promotion to senior positions; in other sectors high professional expertise in the subject field of the parent organisation was similarly regarded. Where professional qualifications in information work were required, these were in librarianship and not in "documentation", but only rarely were they regarded as equal in status and conditions of employment to the established professional or academic qualifications in the sciences, engineering, medicine, or some of the humanities. A main reason for this could probably be found in the historic attitudes to education and the professions in the various countries.

Technical and economic developments affecting information systems in science and technology, combined with the educational developments and the increasing opportunities (and funds) for research, design and development work in this field since the late 1950s and the early 1960s, have led to an increased demand for education and training programmes and to greater career opportunities for the programme graduates.

We have earlier noted four levels of work and a set of programmes to prepare for these; at the first professional level we envisaged that the majority of programme graduates would be engaged in operational work, but also that most of them would, during their career, be involved in some development and design work. We will now, therefore, identify the core of topics to be studied by every professional worker at the first level, and, further, the topics which merit special consideration in the selection of options, bearing in mind the graduate's needs in terms of specialisation and refresher courses.

Required topics

We have identified three core topics which all students in P2 programmes should be required to study, namely:

(i) Organisation and dissemination of data (3.1 to 3.5)

(ii) ISR systems operation (4.5), and

(iii) ISR systems analysis and design (4.1).

In addition, those opting for branch B1 (natural language base systems) should be required to study a fourth topic,

(iv) Data base sources and resources (2.1).

These topics, of which the first is for this purpose to be treated as one rather than five separate topics (see p. 28) each requiring to be studied in depth, should enable the graduate to work in any type of ISR system and also offer the framework to encompass other topics. This core should provide every programme graduate with the basic knowledge and capability in system operation and system design and, especially, in the theories and methods of organisation of data, and documents carrying these, for retrieval.

Recommended topics

Observing current practice in many of the systems might easily lead us to underestimate the complexity and importance of organising and disseminating data in ISR system work. There are apparently no problems since practice hallowed by tradition is not questioned, even though the systems introduced in different circumstances many years ago no longer provide the types and quality of services required by present users. But even questioning is not sufficient in itself. If current practice is to be re-examined successfully, then a deep understanding of the processes and theories involved is necessary, together with a better understanding of the related factors likely to influence any proposed changes.

For branch B1 (natural language base systems), work topics listed under Organisation and dissemination of data in sections 3.1 to 3.5 are particularly important. Complementing these topics, as well as those of the core, are those of Technical equipment for ISR systems: operation and use (5.6), which provide a study of the technical means of potential and actual use in ISR systems. User requirements are studied in Generation and use of data bases (1.1) but systems design and operation also needs to take into account the ISR systems environments (4.4) and the existence of, and practices in, other ISR systems and systems networks (4.3). All these topics are necessary, but not yet sufficient for a well designed programme. An essential component in system operation which should ensure that a well designed system is successful is effective management and we therefore recommend the inclusion of the topic Management principles and techniques (5.5) among these topics.

Optional topics

Whilst a case could be made out for the inclusion of any of the remaining topics, and additional ones, under this heading, we would select four for particular mention, namely Statistical methods of research (5.4), which should usefully contribute to the study of systems analysis and design and systems operational control, Macro- and Micro-characteristics of data bases (2.2), Advanced computer programming (natural language) and Language studies (both 6.1).

Recommended topics for branch B2 (symbol-, graph-base systems) overlap only to some extent with those for B1 branch of work, since B2 branch systems are much more likely to be using computers and a data base generated from within the parent organisation or provided in standardized form by co-operating organisations. Because of the type of the data base, recommended topics include a more detailed study of the Macro- and micro-characteristics of data bases (2.2) in this branch of work, a study of the special problems of Indexes and indexing (3.3), File structure and organisation for retrieval (3.4), and Data transmission, communication and dissemination (3.5). In view of the importance of the computer the study is recommended of Technical equipment for ISR systems: characteristics and use (5.6), with particular reference to computers and computer peripherals and their use, and Advanced computer programming (numerical, graph) (6.1), as is the study of ISR systems and systems networks (4.3) and System/system and system/man interface (4.2). The studies will require a broader background of mathematical studies than studies for branch B1 at the same level, and therefore a study of Mathematical foundations (5.1) is recommended. Finally, as before, management capability is considered as very important and therefore a study of Management principles and techniques (5.5) is included in this list of recommended topics.

Optional topics for B2 branch work: Again, a case could be made for the inclusion of a wide variety of topics, but we would suggest here only one, namely ISR systems environments (4.4), a study of which should usefully contribute background knowledge required both for system design and system operation.

We must now consider some of the factors related to the level of the programmes, such as the minimum levels for entry and graduation.

Entry and output levels

The P2 programmes are intended for preparing students for work at the first professional level and are designed so that graduates can, if they so wish, continue studies to higher levels, normally after gaining some years of practical experience. The appropriate educational qualifications required of applicants to a first professional level programme should be no lower than the normal university or equivalent institution entry requirement in a department such as, say, engineering or economics. It should include adequate ability for expression, orally and in writing, in the national language, reading knowledge in at least one major modern foreign language, and a satisfactory level of achievement in mathematics. It should be pointed out that even this simple specification will correspond to different levels of achievement in different countries because of the considerable differences existing between the educational systems, particularly in respect of the degree of specialisation prevailing in the final four or five years of school education ("school" including two years of college in the United States) and the specialised requirements for entry into different departments of the various university and equivalent institutions.

The graduation level should be equivalent at least to that required of professional programme graduates in universities and equivalent institutions, or in some cases preferably to that of the academic studies graduates. The same difficulty as in equating entry levels applies to the equating of graduation levels on an international scale, but the minimum would correspond to at least an "ordinary" degree of a British (United Kingdom) university, a Licence of a French one, Fil.Kand. of a Swedish one, or MLS of an average university library-school in the United States

We should repeat here that where strong professional organisations exist, graduation from a recognised programme is a necessary but not sufficient component in the election to professional membership, the additional component normally being relevant practical experience carried out under supervision for one or more years, thus ensuring that a professional is competent not only in the theory but also in the practice of his profession.

Organisation of programmes

Full-length first professional level programmes may be organised in two fundamentally different ways according to the role played by the "subject" studies in the natural and social sciences and the humanities, in relation to "information" studies. We shall designate the two approaches as:

(i) integrated programmes, and

(ii) "dual" programmes.

We envisage that in the integrated programmes topics in mathematics, the natural and social sciences, and the humanities will be included in view of their contribution to the study of the bases of information work and information science, and these topics will be a prerequisite for studies in the more "applied" parts of the programme. Thus we envisage a rigorous academic programme of studies of these topics in support of studies of topics such as the Generation and use of information (1.1), Human communication (1.2), Natural and formal languages (2.3), and the Theoretical and technical tools (5.1 to 5.6), the wealth of this material already being so great that a wide range of options can be provided. The approach in the integrated programmes would thus not be unlike that adopted in many engineering and medical programmes where some of the more fundamental topics are studied so as to provide the required basis for the more applied parts of the programme. What is not wanted in an integrated programme is an addition of a few options in scientific (or other academically "respectable") topics taught at an elementary level and for other purposes.

In the "dual" programmes the "information" and the "subject" studies are separate, the function of the "subject" studies being to provide sufficient subject expertise to aid in the operation and design of ISR systems in and for a particular "mission" or "discipline". Thus, for instance, a student intending to work in ISR systems in chemistry would probably study chemistry at a major level with physics, biology, and/or mathematics at minor levels and the same applies to other "subject" areas. In view of the limited time available for the "subject" studies compared with the time available to a student specialising entirely in the subject, the level achieved may not be quite sufficient for some purposes, for instance, where expertise is required for evaluating the contents of documents. The level of "subject" expertise will also depend on the programme admission requirements, and in most subjects it is desirable for these to include appropriate subject studies in school, if a good level is to be achieved in the limited time available.

A variant of the "dual" programme is the "two-stage" programme, where the first part of the programme is devoted entirely to the "subject" studies to degree level, followed in the second part by the "information" studies leading to a Diploma or, in the United States, to an MLS. Whilst such programmes take one year longer to complete, there is the advantage that programme graduates achieve a higher level of "subject" expertise and, having graduated in an established academic subject, may find greater acceptability in some sectors of employment.

The student faced with the two fundamentally different types of programmes will need to decide which one of the two will satisfy his needs better. The integrated programmes are suitable for the student not wishing to link his career to a particular subject field (e.g. a branch of science) and interested in proceeding to the study for higher professional level work in stages. Whilst these programmes are primarily designed for ISR systems work, a suitable choice of options would provide a very useful basis for careers in other areas, such as management or operational research. The "dual" programmes, and particularly the two-stage variant, offer a safe choice for a student interested in ISR systems operation work at the first professional level. The possession of academic qualifications in a subject field in addition to the "information" qualification provide a measure of career flexibility for the student wishing to keep open the possibility of a career in the subject field outside ISR systems work.

Finally, we need to indicate the proportion of effort (time) to be devoted to the "subject" and the "information" topics. In the integrated programmes the subject topics are part of the information topics and therefore the problems of balance between the two does not arise. However, we believe that it is useful to concentrate in the programmes on the fundamentals, and we would therefore expect that a ratio of between 1:1 and 2:1 be maintained between the study of the basic topics (in mathematics, the natural and social sciences and the humanities), and the "applied" information topics. In the "dual" programmes a ration of 2:1 for the effort (time) to be devoted to the subject and information topics would probably be appropriate, this ratio increasing to 3:1 for the two-stage programmes, which might comprise a three-year study for the first degree and a further year for the Diploma or other certificate. We should again stress the need for interpreting the figures in the light of the educational system in the country concerned, since a three-year university programme in one country does not necessarily correspond to a three-year programme in another in terms of input and output levels.

Programmes P3, P4, and P5: Second professional

The existence of "sophisticated", complex, and large ISR systems requires, particularly at the senior levels, staff with more than first professional level competence in management and systems development. Moreover, the growing number of such systems and their increasing "sophistication" and complexity call for more staff with a high level of professional expertise in ISR systems design. In the past, and in most countries even now, all such senior staff acquired the necessary level of expertise through an accumulation of personal experience at work, and many have been outstandingly successful in this endeavour. A high proportion of the most successful ISR systems managers and designers have never taken part, as students, in a university, academic or professional programme; on the other hand, some of those who did, are not successful. An analogous situation arose some years ago in the field of management education, and the case for an academic educational programme was made by Professor S. Eilon. It applies with equal force here. He stated:

> "Let us face it: some people go through an engineering college and never become good engineers; others become first class engineers without any formal education. This does not prove that engineering education is not worthwhile. Similarly, I do not think that the question whether management education can produce good managers or not is a relevant one. The question is whether it can produce <u>better</u> managers. Naturally, you must have a flair for management and certain personal attributes, as indeed for any subject or profession you choose as a career, and without appropriate prerequisites it is doubtful whether any educational programme can guarantee to produce good managers, good engineers, good doctors, or indeed good practitioners in any field of human endeavour. But given the aptitude and inclination for a certain subject, surely the individual stands to benefit from a course which provides a broad background which attempts to knit together relevant problems and issues and which relates past and present human experience in the field, rather than to struggle on his own and learn from his slowly accumulating narrow experience."

We identified earlier three pairs of programmes at the second professional level, namely P3 for those aspiring to senior management positions in large and/or sophisticated systems

P4 for senior systems analysts, designers, and consultants particularly interested in operational systems, and P5 for senior systems designers for experimental and pilot systems requiring a substantial knowledge of applied research and involving possibly some additional research. We shall now consider topics of interest in the individual programmes, and common factors such as the entry and output levels and the organisation of the programmes.

Programmes P3

The main accent in these second professional level programmes is on the management of ISR systems, the secondary one on their development and design. We envisage that the senior manager will, in general, be less concerned with some of the technical detail of day to day operation than a member of staff at the first professional level, but considerably more concerned with broad policy in relation to the institutional and wider needs (e.g. regional, national, international, or discipline). He will be very much concerned with problems of staff morale, and with the effective and efficient organisation of the financial and other resources. The difference between his needs and those of a student at the first professional level will be reflected not only in the selection of topics and the relative importance attached to them, but also in the treatment of the apparently identical topics which at the second professional level will lay greater stress on broad principles, theory, and management implications.

Required topics

The core of a P3 programme comprises five topics, namely:

(i) ISR systems operation (4.5).

(ii) Organisation and dissemination of data (3.1 to 3.5).

(iii) Management principles and techniques (5.5).

(iv) ISR systems environments (4.4), and

(v) ISR systems analysis and design (4.1).

In this part of the programme, the study of ISR systems operation, analysis and design provides the general framework for all the studies. The essential function of any ISR system, that of the organisation and dissemination of data, is studied in more detail (but again, as in the P2 programmes, as one topic at this stage), and the management problems already touched on in the study of ISR systems operation are studied in considerably greater depth and breadth. An ISR system does not operate in isolation, and it is the "environment" in which it does operate which has considerable implications for the design, operation and management of the system; the study of ISR systems environments is therefore an essential part of the programme core.

Comparison with the first professional level programmes shows that the study of Management principles and techniques and of ISR systems environments has now been included in the required topics, but that at this level the formal study of Data base sources and resources (2.1) is not considered as absolutely essential, even for a B1 branch programme at the second professional level.

Recommended topics

An ISR system is a complex system comprising "men, machines, materials, and money". The systems manager therefore requires an adequate knowledge not only of "men" and "money". both considered in some detail in several of the required topics, but also of the other two components. These he can study in Technical equipment for ISR systems: characteristics and use (5.6) and in Macro- and micro-characteristics of data bases (2.2). Additional very relevant background to ISR systems operation and design is provided by the two topics Generation and use of data bases (1.1) and ISR systems and systems networks (4.3).

For students specialising in branch B1 work, the additional recommended topics include Data base sources and resources (2.1), topics in the Organisation and dissemination of data (3.1 to 3.5) and Statistical methods of research (5.4).

For students specialising in branch B2 work, recommended topics include three topics in the Organisation and dissemination of data (3.3 to 3.5), the System/system and System/man interfaces (4.2), Advanced computer programming (numerical, graph) (6.1), and the Mathematical foundations (5.1).

Optional topics

For those specialising in branch B1 work we would mention only three topics, two of which are particularly related to the increasing use of the computer, namely Advanced computer programming (natural language) (6.1) and System/system and system/man interfaces (4.2), and Operational research (5.3) which is of importance in the development and design of complex systems and is increasingly becoming a management tool.

For branch B2 work specialisation the study of Operational research (5.3) and of Statistical methods in research (5.4) should be particularly useful.

Programme P4

In these second professional level programmes the main accent is on ISR systems design and development and the secondary one on systems operation, this being the reverse of the order of priorities in the P3 programmes. The graduate will be particularly concerned with the development and design of operational systems rather than experimental or pilot ones; therefore he will need a good understanding of managerial and technical problems likely to be encountered in operational systems.

Required topics

The core of the P4 programmes comprises four topics common to all students and one additional topic required in each branch of work, namely:

(i) ISR systems analysis and design (4.1)

(ii) Macro- and micro-characteristics of data bases (2.2).

(iii) Organisation and dissemination of data (3.1 to 3.5).

(iv) Technical equipment for ISR systems: characteristics and use (5.6), and

either, for branch B1 programmes

(v) Statistical methods of research (5.4),

or, for branch B2 programmes

(vi) System/system and system/man interfaces (4.2).

In the core programme the main framework is provided by the study of ISR systems analysis and design. Particular attention is paid to the study of characteristics of data bases (with the main stress on those of the data bases specially important in the particular branch of work), and to their organisation and dissemination. In the study of technical equipment special attention will need to be paid to the computer.

For branch B1 work, natural language base systems, an ability to use statistical methods for investigation and control is of major importance, both because of the nature of the data base and because of the nature of a large proportion of the syster i.e. libraries.

For branch B2 systems, problems of systems interfaces are of considerable and increasing importance and indeed require to be studied in greater depth than would be practicable under the general topic of ISR systems analysis and design.

Recommended topics

The study of the core topics needs to be broadened and deepened, both in connection with the needs of ISR systems development and design and in connection with ISR systems operations. The needs and behaviour of the actual and potential systems users and of the "environment" in which the system is operating are studied in the Generation and use of data bases (1.1) and ISR systems environments (4.4), and some of the existing systems are considered in ISR systems and systems networks (4.3). Moving to the more specific management problems, the studies should include ISR systems operation (4.5) and, at an even more specific level, Management principles and management techniques (5.5). All these topics are recommended for both B1 and B2 branch programmes.

For branch B1 (natural language base systems) programmes, study in greater depth is recommended of topics included under the heading Organisation and dissemination of data (3.1 to 3.5), and, in view of the importance of computers and systems interface problems, also of Advanced programming (natural language) (6.1) and of System/system and system/man interfaces (4.2).

For branch B2 (symbol-, graph-base systems) further study is recommended of three topics in the Organisation and dissemination of data (3.3 to 3.5). Again, the importance of computers and the nature of the data base strongly suggest that Advanced computer programming (numerical, graph) (6.1) and Mathematical foundations (5.1) be included among the recommended topics for this programme.

Optional topics

For a B1 branch programme, optional topics may usefully include the study of one or more of the theoretical and mathematical topics, such as Human communication (1.2), Mathematical foundations (5.1) and Operational research (5.3), or of a topic particularly useful for operational work, namely the study of Data base sources and resources (2.1).

For a B2 branch programme, study of additional mathematical tools will be useful. The additional optional topics are those of Operational research (5.3) and Statistical methods of research (5.4).

Programmes P5

As in other professions, there appears to exist a wide gap between the operational systems "operators" and the academic scientists. This is reflected both in the infrequency of a discussion between the two, either in the literature or at professional conferences, and in the slow rate of application of research findings in operational-systems design and operation. The solution to the problem of closing this gap is not, in our view, to insist that every professional information specialist follow a heavily theory-orientated programme of studies, but to offer a set of programmes which together would bridge this gap. Such a set is provided by programmes P3 to P5, P5 being designed to contain a strong link between systems design and applied research, which itself is linked with background research by a set of programmes at the advanced professional level. The P5 programmes are therefore a conscious attempt to provide the link between the "field" and academic information science, to promote the transfer of knowledge in both directions, and to speed up the application of research findings.

Required topics

The selection of the five core topics reflects the need for a solid basis of studies for systems design and for some essential mathematical tools. The topics are:

(i) ISR systems analysis and design (4.1).

(ii) Macro- and micro-characteristics of data bases (2.2).

(iii) Organisation and dissemination of data (3.1 to 3.5).

(iv) Technical equipment for ISR systems: characteristics and use (3.6), and

either, for branch B1 work

(v) Statistical methods of research (5.4),

or, for branch B2 work

(v) Mathematical foundations (5.1).

This core programme is similar to that of programmes P4, except for the substitution of Mathematical foundations for System/system and system/man interfaces in the B2 branch programme. This change reflects both the greater importance attached to the provision of a stronger basis of mathematical studies and the difference in the type of system to be designed, experimental and pilot rather than operational.

Recommended topics

The relatively strong theoretical background needs in these programmes are reflected in the selection of the recommended topics.

For branch B1 work a study of Mathematical foundations (5.1), Operational research (5.3) and Research methods (5.2) provides the necessary mathematical tools, a study of Advanced computer programming (natural language) (6.1) an important technical tool. The study of Human communication (1.2) and of Natural and formal languages (2.3) provides an introduction to studies of areas of considerable research interest and potential in practical application.

For branch B2 work, additional mathematics is provided by studies of Statistical methods of research (5.3), and computer use by studies in Advanced computer programming (numerical, graph) (6.1). Language problems related to data base (and some problems related to computer science) are studied in the topic Natural and formal languages (2.3) where, in this programme, the stress is on the formal ones.

Optional topics

Virtually all the remaining topics are of interest in one respect or other and a fairly free choice should therefore be provided for the student to follow his special interests, subject of course to the constraints imposed by the teaching resources available.

Entry and output levels

We envisage that for second professional programmes entry will be selective (either on evidence produced at the time of application or after a probationary period in the programme) on the basis of academic subject, background and achievement, relevant practical experience and achievement (if any), motivation, personality characteristics suited for the proposed work and career, and places available. Entry to these programmes would normally be open only to graduates with at least a "good honours" degree (in terms of a United Kingdom university) or equivalent, although other graduates, or equivalent, may be accepted on the basis of relevant achievements since graduation. It is desirable that all entrants should have had at least a few months of well-planned practical experience in an information system before entering on their studies.

The output level should be no lower than that of a postgraduate Masters degree of a United Kingdom university, or equivalent, this corresponding approximately to a sixth year post-MLS Diploma or a two-year MS in IS degree of a leading university institution in the United States.

Organisation of programmes

These programmes should normally be full-time ones lasting one year for students meeting all the subject and other entrance requirements. From what has already been said about the content and level of programmes P3 to P5, it is obvious that many (if not most) of the topics could be taught in courses common to all the programmes at this level.

It would probably be advisable to arrange the programmes so that most of the topics could be studied in the first two thirds of the time available. This would reduce the formal course load in the latter part of the programme sufficiently to allow for this time, or a substantial part of it, to be devoted to a "Special study" or, in American terminology, Thesis. This Special study is intended as a small-scale research project in the general field of information science and information work, with a two-fold object: firstly to provide the student with an opportunity for studying in some depth a topic within the field of particular interest to him, and, secondly, to provide him with an opportunity for gaining practical experience in formulating, designing, organising, and carrying out independent research work under supervision and guidance.

Programmes P6, P7, P8 and P9: Advanced professional

The objective of these programmes is to provide research-orientated designers and research workers in the broad field of information science and technology. The four directions of specialisation have been broadly categorised as specialisation in advanced design with ability of applying, in the design, findings of applied research (P6); specialisation in applied research with understanding of (and some capability in) design and development (P7); applied research with orientation towards background research (P8); and specialisation in background research with sufficient capability of relating the findings to possible applied research investigations (P9).

Entry and output levels

The entry level should normally be no lower than a "good honours" degree of a United Kingdom university, this being approximately equivalent to a good MS or AM degree of an above average university, or similar institution, in the United States. However, a mature student not possessing such a degree may be allowed to present evidence in support of his application as to his academic and general ability and achievement since graduating or obtaining a qualification recognised as equivalent.

The output level should be that of a Ph.D. or equivalent professional degree, such as DLS or Dr.Ing. (in some institutions).

Organisation of programmes

The normal period of study for a Ph.D. is three years full-time, or more if part-time. As is usual in research degree work in many countries, no prescribed courses need to be completed, the award of the degree depending entirely on the merit of the research work carried out and the written thesis, and the oral examination on this thesis and related topics. It will, of course, be advisable for individual students to attend particular courses on topics of relevance to their research, such as the course on Research methods (5.2), but completion of such a course would not count towards the degree. As a special case, candidates for the second professional level degree should, subject to permission, be allowed to transfer their registration to the advanced level programme, continue their studies by research, and count part or all of the time spent as a candidate for the second professional level degree toward the minimum prescribed period of studies for the advanced professional programme degree.

The studies in these programmes will entail pursuing an individual approved scheme of research under the appointed supervisor for not less than the prescribed period. The thesis embodying the results of the research must form an addition to knowledge, show evidence of systematic study and ability to relate the results of such study to the general body of knowledge in the subject, and be worthy of publication either in full or in abridged form.

Programmes for specialists

Earlier in this chapter we noted the need for programmes for specialists in other fields who are required for work in information systems. We envisage the need, among others, for three "matching section" programmes, namely one each for the:

(i) subject specialist

(ii) liaison officer, and

(iii) computer specialist

SUBJECT SPECIALIST

Even before the turn of the century the growth of scientific literature led to the production of major abstracting publications, and before long to a need for scientists capable of abstracting and indexing the scientific literature for retrieval. The profession of documentalist grew up differently in different countries, largely separately from librarianship in Germany for instance, fairly closely linked with it in, say, the United Kingdom. These differences had implications for the education and training of the "documentalists", reflected in the different views held on, for instance, its organisation.

We believe that the subject specialist has to make a choice between becoming an information specialist with subject knowledge, or a subject specialist with some knowledge of selected areas of information work. For the former we suggest a full professional level programme which will equip him for work in a wide variety of systems and on different aspects of information work; for the latter we advocate a programme of studies limited largely to techniques likely to be of immediate use in a restricted, though very important area of information work, and some background theory.

Required topics

The study of two topics is essential, namely,

(i) Data base sources and resources (2.1), and

(ii) Organisation and dissemination of data (selected topics).

Study of the first topic will enable the subject specialist to carry out searches using a wide range of sources and in a variety of subject fields, as may be required for techno-economic searches; a study of the latter will provide him with the skills required in his work, such as indexing and classifying according to several of the major schemes in his subject field, to produce indexes, bibliographies and surveys, write and produce abstracts, and edit technical material and prepare it for publication.

Optional topics

For subject specialists expecting to take charge of small systems, study of ISR systems operation (4.5) may be advisable.

Entry and output levels

This programme not being a professional one, there is no need to prescribe these levels. Normally one would expect a subject specialist to have at least a degree level knowledge of his subject, and be already engaged in information work, at least on a part-time basis. On completing the programme of studies the subject specialist should be capable of working either as a specialised member of a large information unit, or as a specialist in charge of a small (probably industrial research) unit.

Organisation of programme

This programme can usefully be organised on a unit system for part-time study, where each topic is divided into small, self-contained units for the lecture and "laboratory" sessions. Six three-day sessions, four one-week sessions, or an evening course over twenty weeks at two three-hour sessions, per week, should provide sufficient time for the required (and some optional) material to be covered in appropriate detail and depth.

LIAISON OFFICER

The need to promote efficiency and innovation in the smaller industrial firms and, earlier, in agriculture, has led in a few countries to the development of technical (and agricultural) liaison services where the function of the liaison officer is to discover the problems and their nature, and to obtain for the "client" expert advice. This advice may be based on a literature search but is more likely to come from the appropriate expert or as a result of a special (experimental) investigation. Experience has shown that it is necessary for the liaison officer to visit his "client" and help him in identifying the problems worth investigating further, rather than to expect the client to come with a properly formulated query. Experience has also shown that only a small proportion of the problems are of an advanced technical nature, many being in the area of management and "know-how".

Required topics

In addition to an introduction to the art of interviewing and to "salesmanship" for technical liaison work, one topic is essential, namely

Data base sources and resources (2.1).

This topic may be supplemented by a study of the local, regional, national and international information network, with special reference to the needs of the liaison officer in a particular industry or a particular geographical area.

Entry and output levels

The liaison officer must be able to inspire confidence in his "client", who probably is a manager of a small industrial company, in his ability to understand and to obtain a solution to the problems discovered. The technical liaison officer is therefore likely to be a qualified engineer or scientist with "shop-floor" industrial experience and a personality conducive to obtaining co-operation from all those he has to deal with in his work. A short programme of studies should enable him to use his technical expertise effectively in obtaining solutions to problems even outside his own field.

Organisation of programme

A series of three-day to one-week sessions spread over four to six months is likely to be more effective than one continuous session of six to seven weeks. As in the Subject specialist programme, each topic can be divided into small, self-contained units for the lecture and "laboratory" sessions. Provision will need to be made for the continual updating in, for instance, manufacturing techniques, changes in legal provisions, e.g. safety regulations, or sources of information.

COMPUTER SPECIALIST

The increasing use of computers in information systems and the relative neglect of ISR data base and system problems in computer science programmes makes it desirable to include a number of optional topics relevant to ISR systems design and operation in computer science programmes.

Recommended topics: The two main topics are

(i) Macro- and micro-characteristics of data bases (2.2), and

(ii) Organisation and dissemination of data (3.1 to 3.5) (selected topics).

The study of these topics should provide the basis for appreciating the nature of the data bases, the theories and methods of their organisation in an ISR system, the existing and possible future solutions to these problems. This appreciation should help to lower the communication barrier between ISR systems operators and computer specialists and thus speed up the effective and efficient use of computers in ISR systems.

Organisation of programme

These topics may best be introduced in the computer science programmes as options, probably later rather than earlier in the programmes, so that the student will have had some experience in natural language programming, file organisation, and systems analysis and design before starting on his studies of the options.

Chapter 4

ANALYSIS OF SELECTED POSTGRADUATE INFORMATION SPECIALIST PROGRAMMES IN THE UNITED STATES AND IN EUROPE

Topics offered in programmes: United States

While the present study was in progress, an important report was published in the United States analysing in some detail the courses currently being offered in United States and Canadian university schools in information science, and supplementing this analysis by a "Delphi" workshop which attempted to identify and weigh the relevance of topics in courses.

The survey revealed that in 1969/70 there were forty-eight schools offering courses in information science, as defined by the American Society for Information Science, on a regular basis. Two of them, however, did not associate their programmes with information science, and one failed to reply in time. Of the forty-five schools only nine had more than three courses which were information science related, the other thirty-six offering little more than an introductory or survey course. This figure of nine must be seen in relation to the one hundred or so universities offering postgraduate programmes in librarianship and/or information science in the United States.

The 185 courses analysed covered a total of 242 topics (not all mutually exclusive), but because of the great diversity of objectives, and of views held by those concerned with the planning of these courses, little correlation appeared between a course "label" and its component topics.

Grouping the courses under seven heads and adding up the different topics included in the courses in the Schools (S), and those recommended as component topics by a "Delphi" workshop of the Curriculum Committee of the Education in Information Science group of the American Society for Information Science (D), we obtained a much sharper picture of the "important" topics in courses, tabulated in Figure 4 et seq.

Figure 4

NUMBERS OF TOTAL (S D) AND IMPORTANT (S D) TOPICS

Courses	Topics S D	Topics S D	$\frac{S\ D}{S\ D} \times 100$
Introduction to information science	62	11	18
Systems theory and applications	37	11	30
Mathematical methods in information science	31	6	19
Computer organisation and programming	28	7	25
Abstracting, indexing cataloguing	30	14	47
Research methods	27	4	15
Communication, information, coding theory	17	0	0

There thus appears to be a fair amount of agreement between what is being offered in courses in the Schools and what the "Delphi" workshop experts consider should be offered in courses on abstracting, indexing, and cataloguing. There is decreasing agreement, however, for systems theory and applications, computer organisation and programming, mathematical methods in information science, introduction to information science, and research methods, where out of 27 topics identified by the Schools or the experts or both as topics which ought to be included in courses, only four were identified by both the groups.

A course in communication, information and coding theory was found to be necessary by the group of experts, and although no courses were being offered under this heading, seven out of the 17 topics identified as important were actually being taught in other courses in the Schools.

The lists of topics considered important in the various courses taught by the Schools and drawn up by the experts overlap to a certain extent, but in any case these lists present a rather fuzzy picture. A much clearer picture can be obtained by compiling the composite lists reflecting only the area of agreement. The lists of topics identified as important by both the Schools and the "Delphi" workshop experts are given in Figure 5 to Figure 10 where the number of Schools including each particular topic in a given course is also shown.

The listing of topics included in courses is not necessarily the best one for designers of programmes who may decide to bring together topics in a different way and under different course headings. It is therefore useful to list the same topics, that is those considered important by both the Schools and the experts, in a systematic order of clusters of topics. These clusters do not correspond exactly to the clusters in the previous chapter, partly because of differences in terminology, but more important, because of differences in point of view. These lists are tabulated in Figure 11 to Figure 17.

Figure 5

IMPORTANT TOPICS IN INTRODUCTION TO INFORMATION SCIENCE

Topics	Schools (total: 45)
Analysis of information	38
Information storage and retrieval	35
Indexing	31
Content analysis	30
Data processing	19
Bibliographic control	18
Library science and ISR	17
Information transfer	14
Information centres and mass communication	13
Information resources	10
Information needs	9

Figure 6

IMPORTANT TOPICS IN SYSTEMS THEORY AND APPLICATIONS

Topics	Schools (total: 45)
Systems analysis	24
OR and information systems	19
System design	16
Design of information systems	13
Evaluation of information retrieval systems	11
Management information systems	9
Information storage and retrieval	9
Information system environment	9
Information transfer	7
Evaluation methodology	7
Measures of effectiveness	6

Figure 7

IMPORTANT TOPICS IN MATHEMATICAL METHODS IN INFORMATION SCIENCE

Topics	Schools (total: 45)
Mathematical logic	10
Set theory	7
Probability distributions	5
Graph theory	3
Algorithms	3
Statistical analysis	3

Figure 8

IMPORTANT TOPICS IN COMPUTER ORGANISATION AND PROGRAMMING SYSTEMS

Topics	Schools (total: 45)
Computer programming	12
Data processing	10
Machine languages	6
File organisation	5
Information storage and retrieval	4
Coding	3
Algorithms	3

Figure 9

IMPORTANT TOPICS IN ABSTRACTING, INDEXING, CATALOGUING

Topics	Schools (total: 45)
Indexing	8
Abstracting	7
Content analysis	7
Classification	7
Auto-indexing	7
Extracting	6
Thesaurus	6
Co-ordinate indexing	5
Derived indexing	4
Information storage and retrieval	4
Bibliographic control	4
Consistency in indexing	3
Subject headings	3
Citation indexing	3

Figure 10

IMPORTANT TOPICS IN RESEARCH METHODS

Topics	Schools (total: 45)
Research techniques	5
Decision processes	4
Design of experiments	2
Evaluation methodology	2

Figure 11

CLUSTER OF "IMPORTANT" TOPICS
INTRODUCTION TO INFORMATION SCIENCE AND MANAGEMENT

Topics	Schools (total: 45)
Storage and retrieval	
Information transfer	14-21
Library science and ISR	17
Information storage and retrieval	35-45
Evaluation of information retrieval systems	11
Management information systems	9
Theoretical aspects	
Information needs	9
Information resources	10

Figure 12

CLUSTER OF "IMPORTANT" TOPICS IN
IDENTIFICATION OF INFORMATION CONTENT

Topics	Schools (total: 45)
Methods of analysis	
Auto-indexing	7
Co-ordinate indexing	5
Abstracting	7
Citation indexing	3
Extracting	6
Derived indexing	4
Indexing of documents	
Analysis of information	38
Indexing	31-39
Content analysis	30-37
Bibliographic control	18-22
Classification	19-26
Thesaurus	6
Subject headings	3
Consistency in indexing	3

Figure 13

CLUSTER OF IMPORTANT TOPICS IN DATA PROCESSING

Topics	Schools (total: 45)
Methodology	
Data processing	19-29
File organisation	5
Coding	3

Figure 14

CLUSTER OF IMPORTANT TOPICS IN SYSTEMS THEORY AND APPLICATIONS

Topics	Schools (total: 45)
Analysis	
Systems analysis	24
OR and information systems	19-25
Decision processes	4
Design	
System design	16
Design of information systems	13
Evaluation	
Evaluation methods	7-9
Measures of effectiveness	6
General	
Information system environment	9

Figure 15

CLUSTER OF IMPORTANT TOPICS IN MATHEMATICAL TOOLS

Topics	Schools (total: 45)
Mathematics	
Mathematical logic	10
Set theory	7
Graph theory	3
Statistical methods	
Probability distributions	5
Statistical analysis	3

Figure 16

CLUSTER OF IMPORTANT TOPICS IN RESEARCH METHODS AND SIMULATION

Topics	Schools (total: 45)
Research methods and simulation	
Research techniques	5
Design experiments	2

Figure 17

CLUSTER OF IMPORTANT TOPICS IN COMPUTERS AND COMPUTING

Topics	Schools (total: 45)
Theoretical	
Algorithms	3-6
Applied	
Computer programming	12
Machine language	6

These tabulations of clusters of "important" topics reveal rather more clearly than do the tabulations of the topics under the course headings the relative "popularity" of these topics in the Schools in the United States, and particularly that:

(i) most, or possibly all, Schools include at least a survey of information storage and retrieval, indexing, and content analysis in their course offerings,

(ii) about one half of the Schools include (computerised) data processing,

(iii) about one half of the Schools specifically include topics on systems analysis and design,

(iv) very few Schools include much about abstracting or extracting,

(v) only a very few Schools appear to include topics in the area of mathematical tools and scientific bases of the subjects taught, or teach research methods.

It should be added here that all the seven Schools visited in the course of the O.E.C.D. study include in their programmes not only the above "popular" topics, but also many of the more rarely taught mathematical and scientific ones. We shall return to a discussion of the programmes in these Schools later in this chapter.

Topics offered in programmes: Europe

The development of university-based programmes for information specialists has been rather slower in European countries of the O.E.C.D. than in the United States and this for various reasons, not the least ones being the differences in the "philosophies" of education and particularly of higher education, and the attitudes to technology. As a consequence there appear to be only two O.E.C.D. countries in Europe where programmes leading to a Masters degree in this field are available, namely the United Kingdom and Yugoslavia. In several more of the European countries study programmes exist for university graduates, leading to a Diploma awarded by academic, professional, state, or other bodies, some of which compare not unfavourably with Masters degree programmes in the United States.

In order to obtain some picture of current programmes for graduates in Europe, we originally selected for further study one programme in each of six countries, namely France, the Federal Republic of Germany, the Netherlands, Sweden, the United Kingdom, and Yugoslavia. Subsequently, however, as a result of observations made, two further programmes were included, one in France and one in Germany. The intention behind this selection was to obtain a broad picture of programmes in Europe, rather than one in depth for any particular country, and to select in each country one of the leading current high level programmes. We therefore excluded from consideration one or two planned programmes which, however, had not become operational by 1971. The selected programmes are listed in Figure 18.

In contrast to the normal structure of university programmes for information specialists in the United States, the existing programmes in Europe were designed as complete "packages" rather than as assemblies of courses designed at different times and, possibly, with different objectives in mind. However, methods for constructing programmes are becoming more flexible, so that Schools in the United States are moving increasingly towards the use of the "package" design, and those in Europe towards flexibility through offering options in parts of programmes.

With the limited number of programmes studied and their wide range of objectives, it would not be useful to analyse these in the same way as was done for courses in 45 Schools in the United States in the ASIS study. Further, since the "courses" in the European programmes have, in general, no independent existence as a unit in individual Schools, separate from the "package" programme of which they form part, course "labels" have not the same significance as in the United States. In order to obtain some picture of the coverage of the eight programmes, we have analysed these in terms of the topics used for the programme design in the previous chapter, and summarised the results in Figure 19. It should, however, be borne in mind that the level, breadth, depth, and type (theoretical, practical) of treatment of any individual topic will differ considerably between the programmes.

The programmes analysed in Figure 19 are arranged according to their objectives, ranging from programme N1 for subject specialists for searching and evaluating data, to programme G2 for information specialists in applied research and development in the area of computerised ISR systems.

As we move from programme N1 to programme G2 the topics become rather less sharply defined, the level, depth, and breadth of treatment increase, training in the practical aspects of operational work, such as abstracting or classifying by a conventional scheme, decreases, and the accent on theoretical foundations and the use of mathematical and technical (computers) tools increases. The application and use of computers in ISR systems, which is only briefly touched on in the N1 programme, is given about 10 per cent of the total time in the S1 and G1 programmes, and increasing proportions in the other programmes, with up to about 75 per cent of the total time in the G2 programme.

Figure 18

LIST OF THE SELECTED PROGRAMMES IN EUROPEAN COUNTRIES OF THE O.E.C.D.

France

F1: Institut d'Etudes Politiques de Paris,
27 rue Saint-Guillaume,
Paris 7e.

Course leading to the Higher Diploma in the Specialisation of Information and Documentation (Cycle supérieur: Diplome supérieur de spécialisation en information et documentation)

F2: Institut National des Techniques de la Documentation,
Conservatoire National des Arts et Métiers,
292 rue Saint-Martin,
Paris 3e.

Course leading to the Higher Diploma in the Sciences and Techniques of Information and Documentation (Deuxième cycle: Diplôme supérieur des sciences et techniques de l'information et de la documentation)

Germany

G1 Lehrinstitut für Dokumentation,
Deutsche Gesellschaft für Dokumentation,
19 Westendstrasse,
6 Frankfurt (Main) 1.

Course for the education and training of Academic (-grade) Documentalists (Jahreslehrgang zur Ausbildung wissenschaftlicher Dokumentare)

G2 Zentralstelle für maschinelle Dokumentation,
Herriotstrasse,
6 Frankfurt (Main)-Niederrad

		Postgraduate education and training programme for information scientists specialising in indexing and retrieval (Nachuniversitäre Ausbildung von Informationswissenschaftlern auf das Fach Indexing und Retrieval)
Netherlands	Nl:	Gemeenschappelijke Opleidingscommissie, NIDER-NVB-NVBA, 19 Burg. van Karnebeeklaan, The Hague.
		Course for subject specialists (information officers) (Cursus C: Literatuuronderzoek)
Sweden	S1:	Swedish Council for Scientific Information and Documentation, S-100, 72 Stockholm 43.
		Course in information and documentation techniques (Kurs i informationssökning och litteraturtjänst).
United Kingdom	UK1:	Postgraduate School of Librarianship and Information Science, University of Sheffield, Western Bank, Sheffield S1 2TN.
		Course in information studies leading to the degree of M.Sc. in Information Studies
Yugoslavia	Y1:	Centar za studij bibliotekarstva, dokumentacije i informacionih znanosti, University of Zagreb, 3 Trg marsala Tita, 41000 Zagreb.
		Course in librarianship, documentation and information studies leading to the Magistr degree (Postdiplomski studij (magisterij) iz naucnog podrucija bibliotekarstvo, dokumentacija i informacione znanosti)

Figure 19

MAJOR AND MINOR TOPICS IN EIGHT EUROPEAN PROGRAMMES FOR INFORMATION SPECIALISTS (POSTGRADUATE LEVEL)

Topic	Programme							
	N1	S1	G1	F2	F1	Y1	UK1	G2
1. Generation and use of data bases								
(1) Generation and use of data bases		o	o	o		x	x	o
(2) Human communication				o		o		
2. Data bases and their characteristics								
(1) Data base sources and resources	x	o	x	o	x	x	x	o
(2) Macro- and micro-characteristics of data bases	x	o	x	x	o	o	x	o
(3) Natural and formal languages			o	o	o	o		x
3. Organisation and dissemination of data								
(1) Data acquisition, description, compression	x	o	x	o	x	x	x	o
(2) Taxonomies, classification of data	x	o	x	x	o	o	x	x
(3) Indexes and indexing	o	x	x	o	x	o	x	x
(4) File structure and organisation for retrieval							o	x
(5) Data transmission, communication, dissemination	o	x	x	o	o	x	o	
4. ISR systems								
(1) ISR systems analysis and design			o				x	
(2) System/system and system/man interfaces								
(3) ISR systems and systems networks	o	o	x	x	o		x	o
(4) ISR systems environments	o						x	
(5) ISR systems operation	x	x	x	o	x	x	x	o

Cont'd.

Figure 1 (Cont'd.)

Topic	N1	S1	G1	F2	F1	Y1	UK1	G2
5. Theoretical and technical tools								
(1) Mathematical foundations			o	o	o	o		x
(2) Research methods								
(3) Operational research			o	o			o	x
(4) Statistical methods of research			o		o	o	x	x
(5) Management principles and techniques (incl. financial management)			x		o		x	
(6) Technical equipment for ISR systems: characteristics and use (incl. computers)	o	x	x	x	x	o	x	x
6. Special topics								
(1) Advanced computer programming and organisation				o	x	opt.	x	x

Notes:

N1,...G2: see Figure 1 for identification of programmes

x = major topic within the particular programme
o = minor topic within the particular programme
(For interpreting the significance of this analysis, see text)

The proportion of time devoted to a study of data base sources and resources varies irregularly, an unusually small proportion of the total time being devoted to it in the G1 programme.

All programmes allocate a fairly substantial proportion of the total time to the organisation and dissemination of data, although the treatment varies considerably, from a heavy accent on classification by UDC in the N1 programme, to stress on the theory and design of non-conventional classification and indexing systems in, say, the UK1 programme.

ISR systems operation is covered in varying amount of detail, as are the problems of management, but ISR systems design is, in most of the programme, treated inadequately or not at all.

Mathematical methods are considerably more in evidence in these European programmes than in those analysed by ASIS in the United States, and the same applies to the studies of topics in linguistics.

Legal problems (and official standards relating to information work) are important topics in only two programmes, G1 and Y1.

Finally, computer programming is specifically included in programmes F1, F2, UK1, Y1 (as option), and G2, although the treatment does not in all cases appear to be applied to ISR orientated problems. The amount of time devoted to programming in F2 appears to be on the low side.

Level of programmes

Postgraduate, or in United States terminology "graduate", programmes are basically of two kinds, namely,

(i) programmes in which the studies complement undergraduate studies in another field, and

(ii) programmes in which the undergraduate studies form an important element in the foundations on which further studies are built.

Most of the postgraduate studies available for information specialists in the United States and Europe, and some of the programmes for subject specialists, are of the first kind. In these "complementary" programmes no particular assumptions are made about the topics studied at the undergraduate level, and therefore the level which can be achieved in a programme in a limited time, particularly in the mathematical and more theoretical topics, is not likely to compare very favourably with the level achieved in, say, an MS in Physics programme for BS Physics majors. At best some of the

MLS programmes in the United States and various "certificate" or "diploma" programmes for graduates in Europe reach a first professional level (in the sense used in the previous chapter).

Programmes of the second kind may be divided into two categories, namely,

(i) postgraduate level programmes for information specialists, and

(ii) "matching section" programmes for specialists.

Programmes in the first category are, as yet, fairly few in number. In the United States they include several of the MS programmes (in Information, Information and Computer, and Computer and Information Science) and some of the individual programmes followed by students in two-year studies leading to an MLS in one, or possibly two universities. In Europe there are probably not more than three or four programmes, two of which lead to an M.Sc. degree (in Information Studies or Science). In all these programmes specific demands in respect to subject area and/or specific topics studied at particular minimum levels have to be met before entry, so that the studies in these programmes do not have to start ab initio even in the introductory parts, but can build and develop from a first degree level starting point.

In the second category we have programmes for the subject specialist (almost exclusively in Europe) and the proposed computer specialist, in which the programme develops a link between the specialist's expertise in his field and that required for application of the expertise in ISR systems work, building, whenever possible, on the specialist's previous studies. The level which can be reached, at least in some of the topics, in these programmes can be of genuine postgraduate standard.

The comparison of levels is complex and difficult even if restricted to one country only, such as the United States, with its wide range of standards among the numerous degree-awarding institutions and the insistence on breadth at the expense of depth in the first degree (and, often, even higher degree) studies; comparison on an international scale would require a major study in its own right. The differences in the educational systems between O.E.C.D. countries are very considerable, as are the levels of the degrees and other qualifications awarded. The comparison is further complicated by the differences in the relative standing of academic as opposed to professional qualifications, and the standing of "paper qualifications" in general which, in many countries, bear little relation to the performance of the individuals holding them, but is more closely related to the material, and more rarely social, benefits which flow from their possession.

Organisation of programmes

All the programmes in the United States considered in this study are programmes in the Graduate Divisions of universities, but of the eight programmes in Europe only two are university programmes.

The United States programmes leading to a Master's degree at the first level are all based on the course-credit system. This system theoretically allows a student to assemble his own programme of studies, in consultation with the School, according to his needs, from a large list of courses offered by the School and by other departments of the university. Each course extends over one term only, the number of hours of credit usually corresponding to the number of hours in class per week. Courses are intended for various levels, the level of a course usually being identified by the first digit of the three-digit course identification number. Some Schools also require a "thesis", that is a small-scale research study, which, too, is given a certain number of credit-hours. The exact practices, lengths of terms, and regulations vary between institutions, but the credit system is quite general.

The choice of courses is restricted by the Schools, by requiring every student to follow certain required "core" courses and, for those wishing to specialise in particular directions, to follow additional required courses. Moreover, a certain proportion of the courses in a programme has to be at, or above, a given minimum level.

The proportion of required courses in the total programme varies, ranging from less than one-fifth (8 out of 42 units) for the MLS in the University of California, Berkeley, to about four-fifths (14 out of 18 courses) in the MSIS programme in the University of California, Los Angeles. Other Schools, as for instance at the Ohio State University, Columbus, and the Georgia Institute of Technology, Atlanta, provide "package" options for the MS degree, with about one-half of the total credit hours being accumulated by means of required courses, and another one-quarter, or more, by suggested "electives".

The offer, in any School, of a wide range of courses on important topics and at a high level is, of course, no guarantee that students will choose to include these in their programmes, unless required to do so, and even a fleeting observation of classes in United States Schools shows that the more mathematical and the more theoretical courses are attended mainly by doctoral programme and special students, rather than by Master's programme ones. To this extent, an analysis of the courses offered by United States Schools does not indicate clearly the topics actually studied by substantial numbers of the students, and especially by those at the Master's level. Further, even though relatively few Master's programme students do attend the more advanced courses, the gap between the best and the poorest of the group of students in the class often causes considerable difficulties in teaching and in attempting to attain simultaneously a high level of achievement and a high level of student success in these courses.

The problems caused by the heterogeneity of the student group with respect to the topics being taught are not particular to the credit-based programmes usual in the United States; they can also be found in these "package" programmes in Europe where in the selection of students and in the organisation of the programmes and courses this "homogeneity" factor has been ignored. Programmes in the United States and in Europe comprise those admitting only full-time, only part-time, or both full- and part-time students, the first two being more common in Europe, the third one in the United States.

While a discussion of the respective merits and disadvantages of full-time, part-time, and mixed schemes would not be appropriate here, since this is a factor which is not limited to education in one field alone, we consider that part-time education is suitable only for relatively short courses and for operation-orientated programmes where the practical experience gained in the day-to-day work in an ISR system complements and supplements the formal studies. We know that many study for a university degree or other high qualifications part-time, and that for many this is the only way in which they can study, but nevertheless we believe that in the circumstances prevailing in most of the O.E.C.D. countries this method is only second-best. A higher proportion of part-time students do not complete their academic studies, even in well-staffed and well-equipped institutions; moreover, the pressures of time on the student result in a concentration on the immediately relevant, at the expense of the broader reading and exploration. If, however, part-time education is to be provided for, then the supply of teaching staff and other resources (such as adequate libraries and "laboratories") must be at least as good as for the full-time student.

Schemes in which both full-time and part-time students are admitted are probably most easily organised in those credit type programmes in which the degree of interdependence between courses is small. Even with this minimum of interdependence, most of the important courses have to be repeated several times in one year, so as to allow the part-time students to complete their programmes of studies in a reasonable time. The teaching manpower resources required are therefore likely to be fairly substantial and the scheme can hence be operated successfully only in the larger Schools.

Having briefly discussed the organisation of credit-based programmes and the problems of organising programmes for part-time students, we should at least outline the "philosophy" of the integrated programme for full-time students, which is probably most highly developed in the School in the University of Sheffield. Here homogeneity of the student group (in the M.Sc. programme) in respect of most of the topics in the programme is achieved by selecting students with an honours or higher degree in science, mathematics, engineering, or other mathematically orientated studies, and by ensuring that before beginning his studies in Sheffield every student has had at least two months of relevant practical experience. In actual practice, over the past few years about one in five of the students in the programme had a science doctorate and an increasing proportion of the students one full year of practical experience.

The one calendar year programme itself is organised so that the studies follow a "critical path", that is one in which the sequence of the topics studied, and sometimes even of the individual lectures or seminars, is determined by the need for pre-requisite background, so that in seminars, tutorials or lectures at any stage in the programme it can be assumed that the necessary background knowledge will have been acquired by all the students earlier in the programme. Visiting lecturers and visits to various ISR systems are carefully phased into this programme to meet these "critical point" requirements.

Although organising the programme of studies in this way is very laborious and time-consuming, the major benefits include a more efficient use of the students' time than by a course credit-based programme. The integrated programme "package" does not preclude some choice, and the availability of a few minor options and of the "special study" (i.e. "thesis") ensure that the study of the "required" topics amounts to no more than about two-thirds of the total time available, a figure which compares not unfavourably with that of some of the programmes in the United States.

Objectives of programmes

In the study of selected programmes in the United States and Europe, we have concentrated in this report mainly on those for graduates at professional levels. However, although we did not study any of the sub-professional level programmes we would point out that staff, at the assistant (technical) level as well as professional staff in related fields (e.g. librarians, computer programmers and analysts), are essential if professional level information specialists are to carry out their work effectively and efficiently. The provision, in any country, of programmes for information specialists must therefore be considered in this context and not in isolation.

Programmes in United States Schools cover a very wide range of objectives, particularly since some Schools allow a considerable measure of choice in individual programmes of study. Bearing this in mind, a distinction in orientation can be discerned between the programmes in the library orientated Schools and those in the "information science" orientated ones.

The programmes in the library oriented Schools are increasingly moving in the direction of the systems approach, in which a library is considered as an example of a system, and toward incorporating in the programmes at least the basics of systems analysis and design. In some Schools (e.g. Chicago) the systems approach is mainly linked to the use of a computer in a library, in others (e.g. University of California, Los Angeles) it provides the framework for all, or almost all, the courses in the MSIS programme. In all these programmes it is only, or mainly, the natural language base systems which are considered, and in most cases only the library as the system.

The category of work aimed at in the Master's programmes in these Schools is principally that of systems operator (often equating the system with a library) and only secondarily that of systems developer or designer, an objective which probably is stressed more in the UCLA MSIS programme than in those of the other Schools.

We mentioned earlier that whilst there are considerable difficulties in judging the level of programmes, we believe that the level of most of the MLS programmes is no higher than that of the first professional.

The two "information science" Schools each offer a few carefully designed programme "packages", of which those on "information systems" are probably the most relevant for our purposes. Both the programmes are design orientated and include a fairly substantial amount of theoretical content related both to the study of computer systems and to the study of symbols as carriers of information. Both programmes assume a relatively high level of modern mathematics and some computer programming experience before entry, and probably for this reason they (unlike virtually all the others) attract male graduates in mathematics, science, or computer science and a few graduates in other relevant subjects, such as linguistics.

European programme objectives reflect, to some extent, the importance attached in Europe, but not in the United States, to the subject specialist or subject analyst. This is particularly obvious in the Netherlands (N1) programme, which is specifically designed as a type of "matching" programme for subject specialists, so as to enable them to search and organise, according to well-established procedures, the literature of their subject, to abstract it, and to write survey reports on topics in their field. To a lesser extent this is also true of the Swedish (S1) programme. The German G1 (Lehrinstitut) programme is designed for academic-grade documentalists who, in effect, are intended to be the industrial or scientific special library and information unit senior staff counterparts to academic-grade librarians in the academic and scholarly libraries. The French F2 (INTD) programme is rather more theory and machine-orientated than the German G1 programme but, by making no assumptions about the subject background of the students (and, perhaps, also in view of the organisational factors in this particular programme), it does, in practice, suffer from the difficulties experienced with an heterogenous group of students, at least in the study of some of the topics. The French F1 (IEP) programme is designed for graduates in the social sciences for work in social sciences libraries and information systems, and it also includes a fairly substantial (for European conditions) amount of computer programming and applications work. The Yugoslav (Y1) programme, the only one not visited, whilst at a high level, does comprise an unusual mixture of ancient and modern, including, as it does, two substantial courses in library cataloguing, theoretical topics in communication science and linguistics, an optional course on the anatomy and physiology of the communication system in the human body, and FORTRAN and COBOL programming. The British (UK1) programme is mainly directed toward design and development work in a range of ISR systems, and the adjacent area of systems management, with an introduction to topics in applied research. Finally, the German G2 (ZMD) programme is aimed at development and applied research work, particularly in the application of computers in indexing and retrieval, mainly in the areas of interest to the institute (bibliographies, indexes, etc.).

Apart from the subject specialist "matching" programmes, all but one of the other European programmes studied are oriented toward the B1 (natural language base) systems, and among these mainly to libraries and special libraries, the exception being the UK1 programme which also includes B2 (symbol-, graph-base) systems in chemistry.

In conclusion we may say that while in the United States programme "packages" are becoming slightly more common than in the past, particularly in programmes designed and implemented by mathematics, science or engineering graduates, as in UCLA, Ohio State University and the Georgia Institute of Technology, in Europe there is a movement toward the introduction of a greater variety of and flexibility within programmes.

Figure 20

LIST OF SELECTED SCHOOLS VISITED IN THE UNITED STATES

California:	School of Librarianship, University of California, BERKELEY 94720
	Graduate School of Library Service. University of California, LOS ANGELES 90024
Georgia:	School of Information and Computer Science, Georgia Institute of Technology, ATLANTA 30332
Illinois:	Graduate Library School, University of Chicago, 1100 East 57th Street, CHICAGO 60637
Ohio:	School of Library Science, Case-Western Reserve University, CLEVELAND 44106
	Department of Computer and Information Science, Ohio State University, COLUMBUS 43210
Pennsylvania:	Graduate School of Library and Information Sciences, University of Pittsburgh, PITTSBURGH 15213

Chapter 5

GAPS IN CURRENT PROGRAMMES

Earlier in this study we sketched out some of the expected changes in the demands to be made on information systems in the 1970's, the consequential changes in the functions and structure of the existing systems, and the effects of technological changes. We have indicated the kinds of information specialists who will be required, and presented a set of programmes for the education and training of these (and some other specialists) for the 1970's. Given the desirability of achieving the objectives indicated, and given the existing programmes, what, then, are the gaps needing to be filled?

Branches of work

The objectives which the majority of the existing programmes in most, if not all, O.E.C.D. countries are designed or capable of achieving are, in our view, undesirably limited by the narrow view taken of the field of information science and information work, a view which, if maintained in the future, would leave the education and training in the most important areas for others to fill. We are particularly concerned by the absence, in the great majority of cases, of a consideration of ISR systems other than those represented by libraries, special (particularly industrial) libraries and information units, and in some cases by too close an identification of "information science" with "science information".

The major gap to be filled is that relating to programmes for branch B2 (symbol-, graph-base) systems, which already are of considerable importance in chemistry, pharmaceuticals, and other areas of science, technology, and engineering; combined with B1 (natural language base) systems, they will be of increasing importance in the development of techno-economic-social ISR systems, of data banks for research, production, planning, and marketing, and educational programmed-learning systems, to give but a few examples. Some branch B2 programmes exist in Schools of computer and information science, or in "Informatik" programmes, but if the changes sketched out in Chapter 2 are to be implemented successfully, much greater co-operation, co-ordination, and preferably integration of programmes in library orientated and "information science" oriented Schools will need to take place.

We also identified a need for "matching section" programmes for subject specialists, liaison officers and computer specialists required for work in ISR systems. Although in some countries adequate programmes exist, particularly for the subject specialists, in others these specialists are expected to pick up the required knowledge in their work, possibly with the help of a few one to three-day courses. In other countries programmes for the subject specialists appear to provide too much for the specialist who is to continue working as a subject specialist, but not quite enough for one who is to act as an information specialist (i.e. for ISR systems operation and development). We have not found any "matching section" programmes for computer specialists, and in view of the increasing importance of computers in all types of ISR systems, we believe that such programmes should be provided.

Categories of work

We identified earlier four categories of work, namely, operation, development and design, applied research, and background research, and we believe that the identification of the categories representing the primary and secondary objectives of individual programmes is essential for any discussion of the details of the programme.

The great majority of the existing programmes for information specialists is by design, or implementation, primarily aimed at the operational category of work. Many of these programmes have been forcefully criticised for not being sufficiently "practical" by some of the practitioners in the "field" who require to fill particular vacancies in their units for which fairly narrow ranges of techniques are necessary. At the same time, the programmes have also been criticised by some students as being intellectually too undemanding and too technique-oriented. A solution to this problem which takes account of the expected pressure for "rationalization" in relation to high-cost manpower in ISR systems (predicted in Chapter 2) would be to reorganize work in ISR systems in such a way as to make better use of both the non-professional and the professional manpower. The gap to be filled in many countries thus does not only lie in the provision of better programmes for information specialists, but also, equally important, in the provision of programmes for sub-professional staff, such as the assistant (technical), and of better programmes for other professional staff, such as librarians.

The preoccupation with the need for system operators, who form the great majority of those engaged in the field, and the relatively slow rate of change in the procedures, methods and techniques employed in systems operations, has led to neglect in programmes of the development and design aspects of the information specialists' work. In view of the increasing rate of change in this field, particularly through the advent of the computer, lack of staff with development and design background and expertise will probably, unless remedied, slow down change and hinder the introduction and widespread adoption of new systems.

Provision for education and training in applied research, and even to a greater extent for background research, is virtually nil in the O.E.C.D. countries, with the exception of the United States and the United Kingdom. This, particularly in the larger, economically advanced countries, represents another major gap which, by limiting the number of information specialists available for advanced work in this field, retards the introduction and development of new sophisticated ISR systems. It is also likely to affect the country's international prestige in this field. We do not advocate nationalism in science, but we do suggest that there are problems which are likely to be of greater interest in some countries than in others, such as those relating to language or to national economic, social, scientific and technical priorities. It seems to us that each country has some obligation to contribute, according to its abilities, to the pool of scientific knowledge.

To sum up, we find that in most countries there are large gaps in the provision of suitable education and training programmes for information specialists in each of the four categories of work, for specialists from other fields required for work in ISR systems, and for specialists in related fields, such as librarianship.

Levels of work

We identified earlier four levels of work, namely that of the assistant (technical), and those of the first, second and advanced professional.

At the sub-professional level, programmes similar to the one proposed for the assistant (technical) exist in a number of countries, including the United Kingdom, France, and Germany, although only in the United Kingdom these programmes are available at a large number of centres.

There is a great variety of programmes at the first professional level, but many are unsatisfactory as to their organisation, content, and quality. As pointed out on previous occasions, the pressures resulting from a greater cost consciousness will lead to the "rationalisation" of ISR systems, and with manpower costs rising relatively faster than some of the other major costs, these pressures will tend to enforce a better use of the available professional and other staff. We therefore believe that greater demands will be placed both on the sub-professional staff, such as the assistant (technical), and on the professional information specialist, and that the information specialist at the first professional level will be expected to have reached at least the equivalent of a first university degree. In this connection it is interesting to note the very rapid change which occurred in the United Kingdom during the past few years in the education and training of professional librarians: part-time study and an educational entry level about two years lower than that required for university entry are being replaced by full-time education and an education entry level equal to the basic (minimum) university entry; in fact, currently about one half of the students follow programmes leading to a degree, or already have a degree and are studying for a postgraduate qualification. If this trend continues, it is likely that within the next few years entry to the profession (i.e. on completion of the programmes and after some practical experience) will be largely by graduates, perhaps one-third to two-fifths being first degree graduates in one of the usual range of academic subjects in the sciences, humanities, social sciences, engineering or technology.

The gaps which do exist in many countries are in the provision of high quality integrated first professional level programmes, leading to a first degree of equal standing to those in the more traditional academic disciplines, and post-graduate programmes which are sufficiently challenging and demanding to attract good graduates in other subject areas. We should perhaps point to the discussion of entry and output levels in P2 type programmes where we equated a first degree in some European countries with the MLS in the United States.

Programmes at the second professional level are, as already indicated, virtually non-existent outside the United States and the United Kingdom, but programmes need to be provided, if necessary on an international basis, so that a proportion of the professional information specialists in each country can qualify to this higher level. It is difficult to estimate in general what this proportion should be, but, as a very rough guide, we would expect it to be about one in five, bearing in mind that it may have to rise as the sophistication of new systems increases.

Programmes at the advanced level are even fewer in number, and outside the United States are not likely to be formalised in respect of detailed structure and content, since in most of these countries doctoral studies are based on research and thesis (cf. Chapter 3, the organisation of the Advanced professional programmes). Studies at this level may appear to be luxuries, but if some of the major problems in this and closely related fields are to be investigated, and if at least some of the professionals are to be trained in research, then the resources and facilities for supporting studies at this level will need to be provided in rather more countries and centres than at present.

Content of programmes

The major gap in the existing programmes does not, surprisingly, relate to a topic which is specific to the field of information science or information work, but to one which is, or should be, common to all professional programmes, namely that of management, development and design.

We believe that a professional information specialist engaged in ISR system operation should be capable not only of systematic questioning of current practices, methods and procedures, but also of developing and designing alternatives, and in this he can gain much from studies of ISR systems environments, various behavioural studies of systems users, studies of management principles and techniques, systems analysis and design, and of techniques for investigation, such as statistical methods of research. It is the professional's ability and willingness to question current practices which distinguishes him from the non-professional (who is not able to question), and from the minor bureaucrat (who is not willing even if able, to question). At the more specific level one could point out a number of gaps in particular programmes, but perhaps it will be sufficient to suggest that programmes in the United States would benefit from the inclusion of more study of taxonomies and classification of data, in spite of the rather heavy reliance on thesauri and general classification schemes in current practice.

Chapter 6

DISCUSSION OF SPECIFIC PROBLEMS

Subject knowledge

The three main areas where subject knowledge may be required, are

(i) for operational work as subject specialist,

(ii) for information specialist work in specialised areas, and

(iii) for information studies in general.

We believe that specialised subject knowledge is rarely significant as such below at least degree level or equivalent. This level of subject knowledge is indispensable for work involving the critical assessment and evaluation of material in the field concerned and for classification and indexing in depth. It is, of course, required by a subject specialist, but we do not believe that subject knowledge in a particular specialised subject area should be required of the information specialist.

The subject knowledge required of an information specialist working in a particular area of knowledge, such as science, or economics, should cover related topics which would enable him to understand the problems involved and to have sufficient background for acquiring the subject expertise required. Such a background, to degree level or higher, will not only provide a very useful basis for information studies in general, but also the necessary points of contact with similarly educated ISR systems users, for instance, in an industrial or scientific research establishment.

Practical experience

In our view, practical experience in an ISR system, before setting out on a programme of studies in this field, is valuable and should be recommended, if not made a requirement for entry. The length of this experience should be not less than two months, and preferably more, and should be carefully planned as training.

Although there have been suggestions for the establishment of "teaching libraries" - and presumably there could be other ISR systems where such training would be given - we do not think that, in general, this is a practical proposition, particularly since the bias would most likely be toward training in large academic and public libraries and librarianship. Should it be necessary to encourage the smaller ISR systems, and in the United Kingdom the trainees are paid a small salary by these systems during their training, perhaps some financial incentives could be provided such as, for instance, tax rebates.

In some of the longer programmes, usually those lasting over three or four years (as in first degree studies), it has been found useful to provide practical experience which would normally be inserted before the final year of studies or during the summer vacations. A period of practical training in one-year or shorter programmes is likely to be possible only in exceptional cases.

Programme organisation

It has been suggested that instead of designing integrated package programmes (see pp. 66-67), it might be preferable to design standard "modules" and build up from these a wide variety of different programmes. The advantages claimed for this modular structure include the possibility of offering an increased number of programmes, in addition to the economic and other benefits of standardisation.

It is of course true that mathematically, and in the absence of constraints on selection, very large numbers of different programmes could be built up with relatively few modules, but the benefits are obviously commensurate with the values placed on the overall effectiveness and efficiency of the programmes thus constructed.

The use of modules, which, in fact, may be taken to be identical with the "courses" in the United States, appears attractive to the module designer who can concentrate on producing modules in his special field for wide use; to the teacher who, relieved of having to prepare material for his lectures and seminars, can concentrate on helping his students with their study problems; to the student, who is allowed great flexibility in studying what he finds interesting and believes to be useful and, because of the widespread use of the standard modules, the freedom to continue his studies at another institution; and to the examiner. The module is also attractive to the cost accountant and to the programme organiser, modules being easily costed.

It is surprising that in view of these undoubted advantages, the unrestricted modular structure of programmes appears to be falling into disfavour in the very institutions which have had most experience in using them, especially at the first professional level where, because of the numbers of students, the advantages might have been thought to be greatest.

The main reason for this loss of popularity of standard modules appears to be the realisation of the need to view education and training in terms of objectives, and hence to view the modules in terms of these objectives as well. However, if modules are to be used in programmes with widely different objectives, then in designing the module few or no assumptions can be made in respect of the background knowledge of the students and of their needs; on the other hand, if these factors are taken into account, the module becomes of restricted use and the economic benefits are largely lost.

We should, perhaps, add that in our view the still very widespread use of the modular structure of university programmes in the United States is not based on educational grounds, but on the need for providing simultaneously for full-time, part-time and special students.

Mathematics and statistics

There are at least three reasons for requiring some mathematics and statistics in the programmes for information specialists: the need for a quantitative approach, the need for understanding arguments presented in mathematical (including logical) form and notation, and the need for using mathematics and statistics as a tool. Even though we have not recommended the inclusion of mathematics and statistics as required topics of study for all students and in all programmes, we do assume at least school level acquaintance with these topics sufficient to provide a basis on which to build as required in the discussions of various topics. The concepts of function, sets, mapping, Boolean algebra, probability, and others, are now increasingly being taught, at least at an elementary level, in many primary schools in England and elsewhere, and "modern mathematics" can thus no longer be considered to be beyond the intellectual capacity of any postgraduate student. The level of modern mathematics required for operational work is, in most cases, not very high, and can easily be attained by most students.

We believe that the applications of statistical methods are of more general and more immediate interest than those of "modern mathematics" in management, development, and design of ISR systems; therefore considerable attention should be paid to them.

In both cases, the student is primarily interested in the topics in relation to ISR systems work, and therefore an introductory course in these topics for mathematicians and statisticians, with its necessary stress on rigour of treatment, has generally been found unsatisfactory. The teaching should therefore follow a special programme designed to suit the needs of the students.

Computers

Commercially produced electronic digital computers have been available now for some twenty years or so, and the time has come for this device to be treated as a standard technical tool for ISR systems. We have therefore recommended or required the insertion of the topic on technical equipment and its use in all programmes for information specialists. The topic includes a study of computers and computer peripherals and computer programming basics.

We should also point out that machine (computer) problems, methods and techniques should be considered, together with "manual" ones, within each topic, as appropriate, so that computer applications can be seen in perspective. This will provide all the new information specialists with some knowledge of the actual and potential uses of this powerful tool in ISR systems work and enable them, if necessary, to make use of it.

In this connection it should be noted that in several countries a high proportion (one half to all) of the university students in the sciences, mathematics, and engineering, and in some other subjects, are familiarised with the computer in their undergraduate studies and make use of it in their experimental laboratory work and for calculations, and an increasing number of secondary, and even primary, school children are now being introduced to it. The "problem" of the computer is therefore largely one for the "older" generation rather than for the new undergraduates and graduates, so that in the next decade it will be practicable to make basic computer programming and computer use a pre-requisite.

Languages

The requirement for a knowledge of foreign languages is incorporated in the regulations of most of the leading Schools and programmes. The reasons appear to be two-fold; first for practical reasons for work in ISR systems with a multilingual natural language data base, such as in many libraries and documentation centres, and second for the equally practical reason that a study of the characteristics of natural and formal languages benefits from the comparative element provided by the knowledge of languages in different language areas.

In our view, the best time for studying foreign languages is in school, and the earlier the better. The language requirement should therefore be a pre-requisite rather than a topic for a course in the programme, except in the study of additional languages and particularly the less common ones (e.g. Japanese, Chinese). We believe that on purely objective grounds every information specialist should know English, and have a reading knowledge of at least one, but preferably two, other languages of major importance (see pp. 10-11).

CONCLUSIONS

In most, if not all, the O.E.C.D. countries, the objectives which the majority of the existing programmes are designed to achieve are undesirably limited by the too narrow view taken of the field of information science and information work; this view, if maintained in the future, will leave the education and training in the most important areas for others to fill. There is urgent nedd for fresh emphasis, in most teaching programmes, on topics related to computer work, to the handling of numerical and graphical material, the problems of interdisciplinary working for techno-economic-social systems. There is also a need for "matching section" programmes for subject specialists, liaison officers, and computer specialists required for work in information systems.

A. The issues

The following problems also require consideration:

(a) In most countries there is a lack of training facilities for the supporting staff at the "assistant technical" level.

(b) At the other end of the scale, insufficient attention is being paid to teaching the development and design aspects of information systems.

(c) There is generally a lack of appropriate quality of programmes: in many countries the degrees in information and related sciences are not considered as "good" as degrees in more "academic" subjects (a stigma attached in the universities of many countries to courses leading to professional qualifications). There is clearly a need to up-grade these courses, to attract better candidates by raising entrance requirements, and by doing so to raise the professional standards and standing of the information specialists under training. These questions of standing - status - standards - salaries tend to be linked: progress upward can only be achieved by enhancing all of them.

(d) Attention is drawn to questions of international compatibility of training, the international movement of teachers, or the provision of international training facilities in order to ensure that information staff have the capabilities to work in different countries or to contribute to the staffing of international information systems. The increase of international working, and the observed trends towards networking, make this kind of professional mobility an issue of vital importance.

(e) In most prgrammes, insufficient attention is paid to the problem of the management of information <u>systems and services</u>. Viewed as training for a developing career in information this is regrettable, but seen in the light of national and international requirements for trained systems managers, this is a matter requiring urgent attention.

(f) In most training courses, little attention is paid to the psychological and social behaviour of the potential <u>users</u> of these systems, whether scientists, engineers, managers or others. Inherent in all their training should be the requirement for information specialists to question the value of the services they offer, and to strive to relate these more closely to the specific needs of their users. Such questioning may include also problems of the location of the information centre, of access to it, of presentation of oral rather than written information, and so on.

(g) The <u>social responsibilities</u> and <u>social effects</u> of information specialists should not be forgotten. As information technology becomes even more widely inter-woven with all activities of society, its wider implications need to be examined and should be the subject of explicit study in the programmes for training future practitioners.

(h) The idea of standard "modules" (the American "courses") from which a variety of programmes can be built up is rejected. This concept is seen as conflicting with the overall objectives of a move towards coherent programmes of high quality.

B. <u>The need for action</u>

(i) Each country should determine and assign priorities to its objectives in the education and training of information specialists, as a function of its objectives in relation to information services and of its national economic and social goals more generally.

(ii) Proposed new programmes should be viewed in relation to these objectives, to existing programmes, to manpower needs and, for advanced professional levels, to programmes in other countries.

(iii) Programmes should be mutually supporting and broad enough to enable and facilitate career mobility.

(iv) Efforts should be made to ensure high quality of entrants to these programmes.

(v) Programmes should be implemented in educational or research institutions of equivalent status to those providing comparable qualification in other professions.

(vi) Teaching staff should be encouraged to undertake some research and consultancy work, as an essential element in their own development.

(vii) The teaching institution should build up staff in mutually supporting areas (it is suggested that a full-time staff of four is a minimum starting number for postgraduate schools of information science, and six for a first professional programme).

(viii) The Report proposes that staff-student ratios should be 10:1 at first professional level, 7:1 at second professional level, and 4:1 for research level programmes.

(ix) Professional organisations must seek provision of facilities for achieving high professional standards, and suggest how these may be achieved.

(x) Professional organisations must back up such proposals with sound evidence: they should hence seek statistical data on manpower, qualifications, employment, salaries, etc. as a basis for realistic planning.

(xi) Governments should promote education and training of information specialists by providing funds for promoting approved programmes and research, and by administrative and political means.

(xii) Governments should commission manpower surveys as basis for planning, and should encourage wide discussion across the profession of the plans which they develop.

(xiii) Intergovernmental agencies should ensure the widest collaboration and co-operation between Member countries in formulating education and training policies in this field.

(xiv) International collaboration should be encouraged in all those fields where individual countries may be unable to provide training programmes covering all their needs; such collaboration may be through internationally shared programmes, staff, and/or institutions.

(xv) O.E.C.D. Member countries should encourage personal contact between policy makers, teachers, researchers, practitioners and advanced professional level students by means of study tours, secondment, practical training in information systems and other means.

SELECTED REFERENCES

Page		
3	BROOKS, H., et al.	Science, growth, and society: a new perspective Paris, O.E.C.D., 1971
50	BELZER, J., et al.	Curricula for information science: analysis and development (Report by the Curriculum Committee of the Special Interest Group/Education Information Science of ASIS) Journal of the American Society for Information Science, 1971 22 193-223
38	EILON, S.	Reflections on management science. (Inaugural lecture) London, Imperial College of Science and Technology, 1964

ACKNOWLEDGEMENTS

This report could not have been written, nor the study leading to it undertaken, without the help of many professional colleagues in Europe and the United States, and particularly those who devoted their time and energy to discuss points raised in this report, and many more, conscientiously and frankly. I would also wish to thank those at the Office for Scientific and Technical Information, London, and the Organisation for Economic Co-operation and Development, Paris, for their frank comments and help during this study, and particularly to my colleagues in Sheffield for their patience. I especially wish to thank my wife for ther never failing support and encouragement.

The opinions and views expressed are entirely mine, but many are based on my interpretation of the views expressed to me in these discussions. Since these discussions were "off-the-record", I have not ascribed any of the statements used to individuals, nor have I referred to particular courses or programmes except in the context of information useful as illustrating a feature of a particular type.

Finally, I hope that this report will serve as a useful basis for discussion and action in implementing new, and better, programmes for the education and training of information specialists.

H.S.

OECD SALES AGENTS
DEPOSITAIRES DES PUB CATIONS DE L'OCDE

ARGENTINE
Libreria de las Naciones
Alsina 500, BUENOS AIRES

AUSTRALIA - AUSTRALIE
B.C.N. Agencies Pty. Ltd.,
178 Collins Street, MELBOURNE 3000

AUSTRIA - AUTRICHE
Gerold and Co., Graben 31, WIEN 1.
Sub-Agent: GRAZ Buchhandlung Jos. A. Kienreich, Sackstrasse 6

BELGIUM - BELGIQUE
Librairie des Sciences
Coudenberg 76-78
B 1000 BRUXELLES 1

BRAZIL - BRESIL
Mestre Jou S.A., Rua Guaipá 518,
Caixa Postal 24090, 05000 SAO PAULO 10
Rua Senador Dantas 19 s. 205-6, RIO DE JANEIRO GB.

CANADA
Information Canada
OTTAWA.

DENMARK - DANEMARK
Munksgaards Boghandel
Nørregade 6
1165 KØBENHAVN K

FINLAND - FINLANDE
Akateeminen Kirjakauppa
Keskuskatu 1
00100 HELSINKI 10.

FORMOSA - FORMOSE
Books and Scientific Supplies Services, Ltd
P.O.B. 83, TAIPEI,
TAIWAN.

FRANCE
Bureau des Publications de l'OCDE
2 rue André-Pascal, 75775 PARIS CEDEX 16
Principaux sous dépositaires :
PARIS : Presses Universitaires de France,
49 bd Saint-Michel, 75005 Paris
Sciences Politiques (Lib.)
30 rue Saint-Guillaume, 75007 Paris.
13100 AIX-EN-PROVENCE : Librairie de l'Université.
38000 GRENOBLE : Arthaud.
67000 STRASBOURG : Berger-Levrault.
31000 TOULOUSE : Privat.

GERMANY - ALLEMAGNE
Deutscher Bundes-Verlag G.m.b.H
Postfach 9380, 53 BONN.
Sub-Agent : HAMBURG : Reuter-Klockner ; und in den massgebenden Buchhandlungen Deutschlands.

GREECE - GRECE
Librairie Kauffmann, 28 rue du Stade,
ATHENES 132.
Librairie Internationale Jean Mihalopoulos et Fils
75 rue Hermou, B.P. 73, THESSALONIKI.

ICELAND - ISLANDE
Snaebjorn Jónsson and Co., h.f.,
Hafnarstræti 4 and 9
P.O.B. 1131
REYKJAVIK

INDIA - INDE
Oxford Book and Stationery Co.:
NEW DELHI, Scindia House.
CALCUTTA, 17 Park Street.

IRELAND - IRLANDE
Eason and Son, 40 Lower O'Connell Street,
P.O.B. 42, DUBLIN 1.

ISRAEL
Emanuel Brown :
35 Allenby Road, TEL AVIV
also at
9 Shlomzion Hamalka Street, JERUSALEM.
48 Nahlath Benjamin Street, TEL AVIV.

ITALY - ITALIE
Libreria Commissionaria Sansoni :
Via Lamarmora 45, 50121 FIRENZE
Via Bartolini 29, 20155 MILANO
Sous-dépositaires :
Editrice e Libreria Herder,
Piazza Montecitorio 120, 00186 ROMA
Libreria Hoepli, Via Hoepli 5, 20121 MILANO
Libreria Lattes, Via Garibaldi 3, 10122 TORINO
La diffusione delle edizioni OCDE è inoltre assicurata dalle migliori librerie nelle città più importanti.

JAPAN - JAPON
OECD Publications Centre,
Akasaka Park Building,
2-3-4 Akasaka,
Minato-ku
TOKYO 107 (Tel (03)586 20 16)
Maruzen Company Ltd.,
6 Tori-Nichome Nihonbashi, TOKYO 103,
P.O.B. 5050, Tokyo International 100-31

LEBANON - LIBAN
Documenta Scientifica/Redico
Edison Building, Bliss Street,
P.O.Box 5641
BEIRUT

THE NETHERLANDS - PAYS-BAS
W.P. Van Stockum
Buitenhof 36, DEN HAAG.

NEW ZEALAND - NOUVELLE-ZELANDE
The Publications Officer
Government Printing Office
Mulgrave Street (Private Bag)
WELLINGTON
and Government Bookshops at
AUCKLAND (P.O.B. 5344)
CHRISTCHURCH (P.O.B. 1721)
HAMILTON (P.O.B. 857)
DUNEDIN (P.O.B. 1104)

NORWAY - NORVEGE
Johan Grundt Tanums Bokhandel,
Karl Johansgate 41/43, OSLO 1.

PAKISTAN
Mirza Book Agency, 65 Shahrah Quaid-E-Azam,
LAHORE 3

PORTUGAL
Livraria Portugal,
Rua do Carmo 70-74
LISBOA 2

SPAIN - ESPAGNE
Libreria Mundi Prensa
Castelló, 37
MADRID-1

SWEDEN - SUEDE
Fritzes Kungl. Hovbokhandel,
Fredsgatan 2,
11152 STOCKHOLM 16.

SWITZERLAND - SUISSE
Librairie Payot, 6 rue Grenus, 1211 GENEVE 11
et à LAUSANNE, NEUCHATEL, VEVEY, MONTREUX, BERNE, BALE, ZURICH.

TURKEY - TURQUIE
Librairie Hachette,
469 Istiklal Caddesi,
Beyoglu
ISTANBUL et
14 E Ziya Gokalp Caddesi
ANKARA

UNITED KINGDOM - ROYAUME-UNI
H.M. Stationery Office, P.O.B. 569, LONDON SE1 9 NH
or
49 High Holborn
LONDON WC1V 6HB (personal callers)
Branches at: EDINBURGH, BIRMINGHAM, BRISTOL, MANCHESTER, CARDIFF, BELFAST.

UNITED STATES OF AMERICA
OECD Publications Center, Suite 1207,
1750 Pennsylvania Ave, N.W.
WASHINGTON, D.C. 20006. Tel : (202)298-8755.

VENEZUELA
Libreria del Este, Avda. F. Miranda 52,
Edificio Galipan, Aptdo. 60 337, CARACAS 106.

YUGOSLAVIA - YOUGOSLAVIE
Jugoslovenska Knjiga, Terazije 27, P.O.B. 36,
BEOGRAD

Les commandes provenant de pays ou l'OCDE n'a pas encore désigné de dépositaire peuvent être adressées à :
OCDE, Bureau des Publications, 2 rue André-Pascal, 75775 Paris CEDEX 16
Orders and inquiries from countries where sales agents have not yet been appointed may be sent to
OECD, Publications Office, 2 rue André-Pascal, 75775 Paris CEDEX 16

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 Paris Cedex 16 - No. 32.079 1973
PRINTED IN FRANCE